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May 31, 1975

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NUCLEAR SCIENCE ABSTRACTS

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Published by the ERDA Technical Information Center

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

CARTER, G., See REED, D.J., 30:21824
CASA, A.F., Nuclear energy in Japan, 30:23243
CASARETT, A.P., See KALLFELZ, F.A., 30:21411
CASCI, C., Method for preliminary analysis of MHD generator performance, 30:20916 (AGARD-CP-104)

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTOR CONTROL SYSTEMS/PERFORMANCE
  Optimization of control-rod programming in multiregion nuclear reactors, 30:23184
REACTOR COOLING SYSTEMS/TRANSIENTS
  WFLASH: a FORTRAN-IV computer program for simulation of transients in a multi-loop PWR, 30:23171 (WCAP-8261(Rev.1))
REACTOR CORES/INSPECTION
  Initial results of a holographic tomosynthesis technique for fuel-core inspection, 30:23198
REACTOR CORES/STRESS ANALYSIS
  Methods of stress analysis in use at General Atomic for core design (HTGR graphite moderator), 30:23078 (GA-A-12870)

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

23214 (HEDL-TME-74-16) ANALYSIS OF TEMPERATURE PROFILES IN TRANSIENTLY HEATED UO_2 USING MOLYBDENUM INCLUSIONS. Wilmot, E. L. **(Hanford Engineering Development Lab., Richland, Wash. (USA)).** [nd]. Contract AT(45-1)-2170. 23p. AT.

is indexed as:

HANFORD ENGINEERING DEVELOPMENT LAB., RICHLAND, WASH. (USA)
  Analysis of temperature profiles in transiently heated UO_2 using molybdenum inclusions, 30:23214 (HEDL-TME-74-16)
  HEDL quarterly technical report, January--March 1974. Volume I. Materials technology, 30:21815 (HEDL-TME-74-1(Vol.1))
  Modeling of the post-irradiation fuel-cladding gap in mixed-oxide fuels, 30:23103 (HEDL-TME-74-19)
  Preliminary data report: post-irradiation examination of fuel pins PNL-10-23 and PNL-10-63, 30:23149 (HEDL-TME-74-23)
  Prototype applications loop two years of operation, 30:20928 (HEDL-TME-74-24)

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Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 26244, 26307, and 26381.

25197 ANALYTICAL CHEMISTRY AND METALLURGY. Castro, R. (Ugine Aciers Speciaux, 93-Saint-Denis (France)). Rev. Met. (Paris); 71: No. 5, 409-421(May 1974). (In French).

The following analytical methods are discussed: overall analysis (rapidity, sensitivity, accuracy, reproducibility); local excitation analysis using electron, ion and photon beams; phase analysis. (FR)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 25927, 26073, and 26214.

25198 (BARC-760) APPLICATION OF Pu-Be NEUTRON SOURCE IN ACTIVATION ANALYSIS. Pawaskar, P. B.; Reddy, G. R.; Sankar Das, M. (Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.). 1974. 23p. Dep. NTIS (US Sales Only) $4.25.

The report presents the details of installation and calibration of a 5 Ci ^{239}Pu-Be neutron source system for routine activation analysis. Simple activation methods developed for the analysis of industrially important elements like Mn, Cu, F, Al, etc., using this system are also included in the report and the results obtained with this approach compared with those obtained by conventional chemical methods. (auth)

25199 PHOTONUCLEAR REACTIONS EMPLOYED FOR PHOTOACTIVATION ANALYSIS WITH A BETATRON. Galatanu, V.; Grecescu, M.; Baciu, G. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 9, 973-980(1974). (In Rumanian).

The paper contains a synthesis of the results obtained in the last years with the 25 MeV Betatron of the IAP in the field of quantitative photoactivation analysis. The authors emphasize the advantages of the photoactivation method for the analysis of geological samples as well as the possibilities of the betatron. They describe the different steps of the experimental procedure: irradiation, gamma-spectroscopic measurements, and calibration. Special attention is paid to the problem of disturbing interferences and to the sensitivity of the analytic method. The results obtained on different elements are briefly reviewed and their original features are mentioned. (auth)

25200 DETERMINATION OF SOME ELEMENTS, CONSTITUENTS OF THE LITHOSPHERE, BY NEUTRON ACTIVATION ANALYSIS. Gavrilov, V. M.; Blinov, V. A.; Gedeonov, L. I.; Krivokhatskii, A. S. pp 39-45 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The factor of detectability is that amount of γ quanta of energy E emitted in 1 sec by a radionuclide induced in 1 g of rock of average element composition during activation of the nuclide in an integral flux of 1 n/cm^2. This factor was calculated for the two most intense γ lines of a number of radionuclides. The results are tabulated for use in the activation analysis of rocks and other materials of the lithosphere. (JSR)

25201 DETERMINATION OF THE CONTENT OF W, Mo, AND Ta IN Nb BY NEUTRON ACTIVATION ANALYSIS. Kiselev, B. G.; Faizrakhmanova, N. R. pp 46-49 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The determination of Ta, W, and Mo in Nb-based alloys by thermal neutron activation and measurement of the resulting γ radiation was studied. The samples were irradiated at a flux density of 10^{11} to 10^{14} n/cm^{2}sec as a function of the impurity content of the sample. Metallic alloy shavings with a weight of 500 to 1000 mg were used as samples. The γ measurements were made with a semiconductor Ge(Li) spectrometer with a sensitive area of 23 cm^3. The sensitivity of the method for the three impurities and the interferences caused by each were determined. (JSR)

25202 USE OF CHARGED PARTICLES FOR THE ANALYSIS OF THE LIGHT ELEMENT CONCENTRATIONS. Mazitov, B. S.; Muminov, V. A.; Mukhamedov, S.; Sultanov, B. pp 50-56 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

In the use of protons, deuterons, α particles, and ^{3}He ions for activation analysis, the sensitivity and the detection limits of the impurities depend on the mean free path of the particle in the irradiated material and the cross section of the reaction as a function of energy. The dependence of the cross section on energy is graphed for a large number of nuclear reactions on light nuclei ($Z < 10$). The optimum irradiation energies and the detection limits for the determination of light elements by means of charged particles are tabulated on the basis of literature data. The particles giving the greatest sensitivity are indicated for some of the light elements. (JSR)

25203 POSSIBILITIES FOR THE USE OF INELASTIC SCATTERING REACTIONS OF γ RADIATION ON NUCLEI IN ACTIVATION ANALYSIS. Lomonosov, V. I.; Malinovski, G. B.; Teke, A. A.; Yakovlev, B. M. pp 57-61 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The construction and operation of two measurement complexes for the determination of short-lived isomers resulting from the inelastic scattering of γ radiation are briefly outlined. One is a two-crystal spectrometer and the other is a three-crystal spectrometer and they differ from each other only in the construction of the transducer. A block diagram of each is given. Satisfactory results were obtained in the experimental testing of the installations on samples of rocks, ores, and ore processing products. (JSR)

25204 SOME RESULTS OF THE USE OF Ge(Li) DETECTORS FOR γ RADIATION SPECTROMETRY DURING MULTIELEMENT ANALYSIS OF ROCK AND ORE SAMPLES IN AN ELECTRON ACCELERATOR. Vitozhents, G. Ch.; Voropaev, V. I.; Martynov, Yu. T.; Sulin, V. V. pp 62-66 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The instrumental spectra obtained from a bauxite, polymetallic ore, and a Au polymetallic ore in laboratory tests on the utility of a Ge(Li) detector for γ spectrometry in electron activation analysis are given as illustrations of the type of type obtained. In the bauxite sample natural Th and U γ lines as well as induced Ti, K, Cu, and Zr lines are easily detectable. Lines caused by the activation of Ti, Zn, Ba, Pb, Au, K, Cu, Cd, Sb, As, and Zr are clear. Reliable lines from Au are detectable on the background of Pb and Ba lines in the Au ore. The results obtained show the suitability of the use of semiconductor detectors in the detection of induced γ activities. (JSR)

25205 USE OF AMPULE NEUTRON SOURCES IN THE NEUTRON-ACTIVATION ANALYSIS OF LARGE PORTIONS OF BIOGEOCHEMICAL SAMPLES. Abdullaev, Ya. S.; Saidmuradov, T.; Khatamov, Sh.; Kist, A. A. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 5, 59-60(1974). (In Russian).

Because of the relatively low neutron flux, large samples must be irradiated to attain sufficient sensitivity. The volume of sample to be activated depends on the decrease in neutron flux during activation and the incomplete counting of the induced gamma radiation. With an activity of 50 curies in the Po–Be source, an irradiation time of 30 min and a sample weight of 2 kg the following sensitivities were determined for various elements in soil, minerals, plants, plant ashes and in air-dried animal samples: sodium – 1×10^{-3}%; aluminum – 0.1%; chlorine – 2×10^{-2}%; manganese – 1×10^{-4}%; arsenic – 1×10^{-4}%; antimony – 1×10^{-5}%; and gold – 1×10^{-3}%. The accuracy of the method was confirmed by comparison of these data with the results of reactor activation analysis of standard samples. The accuracy is equal to 5 to 20% depending on the element and type of sample. Equipment is being created for the production analysis of soil samples. (SJR)

25206 STUDY OF PURITY OF SEMICONDUCTOR SILICON PLATES, AND THE DETERMINATION OF CONCENTRATION PROFILES OF GALLIUM AND PHOSPHORUS BY NEUTRON ACTIVATION AND AUTORADIOGRAPHY. Jaskolska, H.; Walis, L.; Rowinska, L. (Inst. of Nuclear Research, Warsaw). Radiochem. Radioanal. Lett.; 20: No. 4-5, 229-239(28 Feb 1975).

Using γ-spectrometry ten elements in silicon plates were detected. With the aid of autoradiography it was shown that the distribution of these elements was inhomogeneous. Concentration profiles of Ga and P were determined using activation analysis for plates implanted with inactive isotopes and by means of β-radiometry for plates implanted with a radioactive isotope. The homogeneity of distribution of the implanted elements was studied by means of autoradiography. (auth)

25207 SODIUM REMOVAL BY HYDRATED ANTIMONY PENTOXIDE IN NEUTRON ACTIVATION ANALYSIS. Krishnan, D. D.; Crapper, D. R. (Univ. of Toronto). Radiochem. Radioanal. Lett.; 20: No. 4-5, 279-287(28 Feb 1975).

The retention of sodium and 19 other trace elements by hydrated antimony pentoxide column has been studied using radioactive tracers. Several concentrations of hydrochloric, nitric, sulfuric, and perchloric acids have been studied. Sodium is retained at all concentrations of the acids while potassium is preferentially retained at low acid concentrations. In 12M hydrochloric acid medium sodium is quantitatively (> 99.9%) retained, while the majority of the other elements are quantitatively eluted. With the other acids the extent of retention depends on the acid concentration and the element. These data are used in designing analytical schemes for trace element analysis of biological and other sodium-containing materials by neutron activation analysis. (auth)

25208 RETENTION OF SILICON ON INORGANIC EXCHANGERS. Rouchaud, J. C.; Fedoroff, M.; Revel, G. (Centre d'Etudes de Chimie Metallurgique, Vitry-sur-Seine, France). Radiochem. Radioanal. Lett.; 20: No. 4-5, 317-322(28 Feb 1975).

We have studied the retention of ^{31}Si on various inorganic exchangers from different aqueous media. Silicon is quantitatively retained on aluminum oxide at pH 9. The quantity of aluminum oxide necessary for the fixation is convenient for direct measurement of the β^- radioactivity of ^{31}Si used for the determination of silicon by neutron activation. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 25274, 25279, 25280, 26214, 26215, 28918, and 28943.

25209 (BARC-759) SPECTROGRAPHIC ANALYSIS OF HIGH PURITY COPPER AND COPPER OXIDE. Rao, A. S.; Dixit, M. N. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

An emission spectrographic method for the analysis of copper and copper oxide for eighteen trace impurities is described. The samples are excited in a dc arc at 10 amp and the spectra are photographed on a Hilger large quartz spectrograph in the wavelength range 2360–3250 Å. A mixture of zinc oxide and graphite is used as a buffer. The matrix line of copper at 2630 Å is used as internal standard line. The elements that can be analyzed by this method are: Al, As, B, Be, Bi, Co, Cr, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Sn, Te, Ti, and V. The standard deviation for the determination of the impurities lies around ±10%. (auth)

25210 (CNEA-268) INFLUENCE OF Ga_2O_3 AND NaF CARRIERS ON THE VOLATILIZATION AND EXCITATION OF VANADIUM, WHEN USING THE SCRIBNER-MULLIN METHOD. Amaya, C. B.; Guido, O. O. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 18p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

The influence of NaF and Ga_2O_3, used as carriers, on the relative emission intensity of the atomic line V 3183.98 Å and consequently on the sensitivity and detection limit of this element by Scribner and Mullin method, was evaluated. The behavior of these two carriers was quite different concerning their influence on the volatility of vanadium. Based on radiometric determination using ^{48}V, a volatilization of 37% with NaF and 0.9% with Ga_2O_3 was determined for the excitation conditions adopted. The use of NaF allowed an important increase in sensitivity, with a decrease in the lower value of the determinable concentration of about fifty times without loss of precision. The contribution of the physico-chemical conditions of the plasma to the emission intensity was not significantly different for both carriers, according to the results from a proposed method of calculation. (auth)

25211 (COO-3119-4) ANALYSIS OF SEA WATER BY DIFFERENCE CHROMATOGRAPHY. Progress Report, January 1, 1973–September 30, 1974. Mangelsdorf, P. C. Jr.; Chang, W. M. (Woods Hole Oceanographic Institution, Mass. (USA)). 1974. Contract AT(11-1)-3119. 56p. Dep. NTIS $6.00.

Modifications of the technique of difference chromatography are described which eliminate the previous NH_4^+ error, permit the analysis of NH_4^+, eliminate anion composition effects, and permit analysis for total normality of mixed electrolyte solutions. Using these modifications the technique of difference chromatography has been used to study the ion exchange properties of assorted fluvial sediments from the North River salt-marsh estuary. The standard method of washing sediments with distilled water after sea water treatment has been shown to lead to serious errors. When this error is avoided, monovalent ions are found to prevail on sediments in equilibrium with sea water. In the North River sediments the bulk of the cation exchange capacity is associated with the organic fraction in the sediments. Difference chromatography was used along with standard methods to determine miscellaneous chemical profiles in sediments from Buzzards Bay and Cape Cod Bay, using interstitial waters collected with the "Harpoon" in situ interstitial water sampler. (auth)

25212 (PB-236356) ANALYSIS OF OXIDE MATERIALS OVER A WIDE RANGE OF COMPOSITION USING A DILUTION TECHNIQUE. Tunney, A. A.; Hughes, H. (British Steel Corp., Sheffield). Aug 1974. 20p. (GS/TECH-300/2/74/C). NTIS $3.25.

In order to extend the field of application of x-ray fluorescence to the analysis of oxide materials, a method based on using lanthanum oxide as a heavy absorber to minimize interference effects was investigated. A 17:2:1 $Li_2B_4O_7$: La_2O_3: sample is preferred. Calibration graphs are illustrated for fifteen constituents of interest, Fe_2O_3, MnO, Cr_2O_3, V_2O_5, TiO_2, CaO, K_2O, P_2O_5, SiO_2, Al_2O_3, MgO, Na_2O, BaC, ZnO, and ZrO_2. The advantages and limitations of the technique are discussed. A correction method based on alpha-factors has advantages but problems in developing such a method are referred to briefly. (GRA)

25213 (SAND-74-8644) POTENTIAL USE OF RAMAN SPECTROSCOPY IN THE QUANTITATIVE ANALYSIS OF HYDROGEN ISOTOPES. Setchell, R. E.; Ottesen, D. K. (Sandia Labs., Livermore, Calif. (USA)). Feb 1975. Contract AT(29-1)-789. 23p. Dep. NTIS $4.25.

Raman spectroscopy is evaluated as a method for analyzing mixtures of hydrogen isotopes. Raman vibrational spectra of the various diatomic isotopes are described, and an existing Raman analysis system is evaluated for sensitivity. An optimized analysis system utilizing an intra-cavity optical cell is described, and its potential sensitivity evaluated. Raman techniques are shown to be capable of accurate concentration measurements with excellent resolution of the diatomic isotopes. (auth)

25214 (Y-1281) COLLECTED METHODS OF ANALYSIS OF ADDITIVES IN METAL HYDRIDE. Schreyer, J. M.; Dietrich, W. C.; Rowan, J. H.; Barringer, R. E.; Hankins, B. E.; Johnson, J. D.; Keys, J. H. (Oak Ridge Y-12 Plant, Tenn. (USA)). 30 Nov 1959. Contract W-7405-eng-26. 63p. Dep. NTIS $6.25.

Declassified 15 Nov 1974.

A series of procedures has been compiled for quantitative determination of tracers in lithium hydride. The series involves a total of 10 different elements in a variety of blends calling for a number of different techniques. These analyses were developed to meet needs arising over a four-year period, and are treated in chronological order. Accuracies of about ± 1% of theoretical

value were obtained for most of the methods developed. They include titrimetric, gravimetric, spectrophotometric, and x-ray absorption methods for determining various combinations of Rh, Th, Tl, Tm, Sc, Y, Lu, Au, Zr, and Rb in LiH; Cd and Tl were determined in LiCl by a polarographic method. (JGB)

25215 (Y-1281(Vol.2)) COLLECTIVE METHODS OF ANALYSIS OF ADDITIVES IN METAL HYDRIDE. Walden, G. E.; Keys, J. H.; Sells, K. A.; Postma, F. W. Jr.; Nicely, J. W.; Barringer, R. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 20 Apr 1964. Contract W-7405-eng-26. 127p. Dep. NTIS $9.50.

Declassified 15 Nov 1974.

Several procedures have been developed and compiled for the quantitative determination of tracers in lithium hydride. The absolute limit of error (0.95) for a single measurement was in the range of ± 0.007 – 0.036% for each element. This is Volume II of these analytical procedures. The original volume (Y-1281) was issued on February 19, 1960. (auth)

25216 (Y-B-65-270) FLAME SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM QUANTITIES OF SODIUM IN URANIUM(VI) NITRATE SOLUTIONS. Barringer, R. E.; Dietrich, W. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). 3 Apr 1959. 13p. Dep. NTIS $4.00.

Declassified 21 Nov 1974.

A method is presented for the determination of trace quantities of sodium in uranium(VI) nitrate solutions. This method is applicable to aqueous uranium(VI) nitrate solutions stripped from organic extraction of salvage materials. Analysis is performed on a Beckman DU flame spectrophotometer unit equipped with a scanning-recording attachment. Sensitivity is sufficient to detect 0.20 μg Na/ml. of solution in a solution containing 10 g U/100 ml. The limit of error (0.95) for a single determination is ±4.2% at the 3 μg Na/ml. level. Direct flame analysis for Ca on the 10% uranium solution did not give sufficient sensitivity for proper monitoring. (auth)

25217 (Y-B-65-621) DETERMINATION OF RHENIUM IN A RHENIUM–URANIUM ALLOY. Steckel, L. M.; Barringer, R. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 28 Nov 1961. 9p. Dep. NTIS $4.00.

Declassified 21 Nov 1974.

A spectrophotometric method for the determination of Re in a Re–U alloy using furildioxime to form a highly colored complex was outlined step by step and evaluated. The presence of U and Th had no effect on the determination. Nitrates must however be removed. The complex is stable for a number of hours. The method is applicable to Th–U–Re and Ir–U–Re alloys. (JSR)

25218 INTERLABORATORY LEAD ANALYSES OF STANDARDIZED SAMPLES OF SEAWATER. Meeting Report. Brewer, P. (Woods Hole Oceanographic Inst., MA); Frew, N.; Cutshall, N. Mar. Chem. (Amsterdam); 2: No. 1, 69-84(Apr 1974).

From meeting on interlaboratory lead analyses of standardized samples of seawater; Pasadena, CA (16 Sep 1973).

The question of whether measurements of lead concentrations in seawater by atomic absorption and anodic stripping voltammetry techniques are as reliable as those determined by isotope dilution is important to researchers in several fields. At a recent International Decade of Ocean Exploration conference it was found that seven chemical oceanographic laboratories of superior status using atomic absorption or anodic stripping voltammetry techniques could not demonstrate a reliable capability for analyzing lead in tuna fish and could not demonstrate a capability for detecting lead contamination in tuna fish that had actually been grossly contaminated. The general feeling of those attending the meeting was that this type of inaccuracy probably extended to analyses of lead in seawater. It was recommended that a workshop be established to carry out interlaboratory lead analyses of seawater standardized by stable isotope dilution mass spectrometric techniques. A workshop was initiated in the fall of 1972. Two samples of seawater and one sample of distilled water were circulated among nine participating oceanographic laboratories during the next six months. The samples were standardized by stable-isotope dilution using mass spectrometric and clean laboratory techniques in one of the laboratories and were analyzed for lead by either atomic absorption or anodic stripping voltammetry techniques in eight of the other laboratories. The aim of this report is to encourage proper application of rapid and inexpensive analytical techniques such as atomic absorption (and emission) and anodic stripping voltammetry to the analysis of lead in seawater and marine organisms. Ultra-careful isotope dilution analytical techniques for lead cannot be used in the majority of needed applications because it is too slow and expensive. It is intended that this report tabulate the work of the participants, interpret agreements and discrepancies, and make recommendations for improving the accuracy of atomic absorption and anodic stripping voltammetry in the analysis of lead in seawater. (auth)

25219 STRAY RADIATION AS AN INNER STANDARD IN X-RAY SPECTROMETRIC ANALYSIS OF TRACE QUANTITIES IN BIOLOGICAL MATERIAL. Plesch, R. (Siemens A.G., Karlsruhe (F.R. Germany). Geschaeftsbereich Mess- und Prozesstechnik). G-I-T (Glas- Instrum.-Tech.) Fachz. Lab.; 18: No. 11, 1106-1112(Nov 1974). (In German).

5 figs.; 3 tabs.; 10 refs.

It was shown theoretically that the ratio between intensity and scattered radiation is much more independent of the matrix than the intensity itself. This is valid too if the background on the place of the peak is used to form the ratio. Studies on biological material ensured that a remarkable decrease of the measured deviations is obtained by using the scattered radiation and especially the background as an internal standard. (auth)

25220 STUDIES ON SYNTHETIC INORGANIC ION EXCHANGERS. IV. Electrophoretic Behavior of Metal Ions on Thorium Phosphate Papers. De, A. K.; Chowdhury, K. (Dept. of Chemistry, West Bengal, India). Separ. Sci.; 10: No. 1, 39-46(Feb 1975).

The electrophoretic behavior of 19 metal ions on thorium phosphate papers is described. Seven background electrolytes were used for these studies to allow different time intervals. On the basis of the differential mobilities of the metal ions, which depend on the ion exchange properties of thorium phosphate and the nature of the complexes formed with the electrolyte, some important binary, ternary, and quaternary separations have been achieved. (auth)

25221 FOAM SEPARATION OF ANIONS FROM AQUEOUS SOLUTION: SELECTIVITY OF CATIONIC SURFACTANTS. Grieves, R. B. (Univ. of Kentucky, Lexington); Charewicz, W.; The, P. J. W. Separ. Sci.; 10: No. 1, 77-92(Feb 1975).

Anions are selectively separated and concentrated from dilute aqueous solution by foam fractionation. Selectivity coefficients are established from steady-state equilibrium data (solution concentrations 10^{-4} to 10^{-3} M) for SCN^-, I^-, ClO_3^-, NO_3^-, BrO_3^-, and NO_2^-, each vs Br^-, with the quaternary ammonium surfactant modeled as a soluble anion exchanger. Studies are reviewed on the foam separation of Re(VII), Mo(VI), and V(V) oxyanions; Au(I), Ag(I), Ni(II), and Co(III) cyanide complexes; and Pt(IV), Pd(II), and Au(III) chloro complexes. In a five-component system, the oxyanions of Re(VII), Mo(VI), Cr(VI), W(VI), and V(V) are foam fractionated from 10^{-6} M solutions with the cationic surfactant, hexadecyldimethylbenzylammonium chloride. In the batch, time-dependent experiments, the metals are monitored by radiotracers and gamma radiation spectrometry. At pH 6.0 and a chloride (NaCl) concentration of 10^{-2} M, and at pH 2.0, adjusted with HCl, Re(VII) and Mo(VI) oxyanions can be separated completely from Cr(VI), W(VI), and V(V) oxyanions. The selectivity sequences are discussed in terms of acid-base equilibria and in terms of the absolute partial molal entropy of each anion in aqueous solution, as a measure of surfactant cation-anion interaction. (auth)

25222 ANALYSIS OF RADIOACTIVE WASTE SUPERNATE BY LASER-RAMAN SPECTROMETRY. Marston, A. L. (Savannah River Lab., Aiken, SC). Contract AT(07-2)-1. Nucl. Technol.; 25: No. 3, 576-579(Mar 1975).

A laser-Raman spectrometric method was developed for the determination of polyatomic ions in alkaline high-level radioactive waste supernates. From peak heights of well-resolved Raman bands, concentrations of NO_2^-, SO_4^{2-}, CrO_4^{2-}, PO_4^{3-}, and $Al(OH)_4^-$ ions are determined relative to NO_3^- ion concentrations in raw solutions. The concentration of an NO_3^- ion is determined independently by quantitative dilution of an aliquot with standardized 2M $NaClO_4$. The relative precision at the 95% confidence level for a single determination is ±5%. Although Savannah River Plant waste samples are pale yellow and turbid, centrifugation clarifies them sufficiently for reproducible spectra to be recorded with 488-nm Ar^+ excitation. (auth)

25223 EVALUATION OF TETRAPHENYLOBORATES. II. Indirect Conductometric Determination of Potassium, Rubidium, and Cesium. Raber, H. (Univ., Graz). Mikrochim. Acta; 1: No. 2-3, 271-275(1975). (In German).

In the reaction of alkali tetraphenyloborates with mercury(II) chloride, there are set free, in addition to phenylmercuric chloride and boric acid, the electrolytes hydrochloric acid and alkali chloride. The observed elevation in the conductance is proportional to the concentration of the potassium, rubidium, or cesium present as the tetraphenyloborate. The calculated values agree satisfactorily with the values obtained experimentally. Procedures are given for the determination of the named alkalis. The specific elevation of the conductance is proportional to the atomic weights of the precipitated elements. (auth)

25224 EVALUATION OF TETRAPHENYLOBORATE PRECIPITATES. III. Indirect Determination of Potassium, Rubidium, and Cesium by Extraction Photometry of Boric Acid. Raber, H. (Univ., Graz). Mikrochim. Acta; 1: No. 2-3, 277-279(1975). (In German).

The extraction photometric determination of isolated tetraphenyloborates with the oxazine dyestuff Nile blue A has been described. After decomposing the tetraphenyloborate with mercuric sulfate the resulting liberated boric acid is extracted with chlorobenzene as a weakly dissociating dyestuff tetrafluoroborate. This procedure permits rapid photometric determinations of potassium, rubidium and cesium. The errors lie in the neighborhood of ±5 rel. %, in a range from 1 to 12 μ-equivalents of alkali ion. (auth)

25225 DETERMINATION OF Te AND Pb IN SEMI-CONDUCTOR MATERIALS BY THE LOW-TEMPERATURE LUMINESCENCE METHOD. Solov'ev, E. A.; Savvina, L. P.; Golovina, A. P.; Granovskii, Yu. V. (Moscow State Univ.). Zh. Anal. Khim.; 30: No. 1, 103-106(Jan 1975). (In Russian).

Mutual effect of lead and tellurium has been studied on luminescence of their chloride complexes at low temperature. A procedure has been developed of determination of the elements in an alloy containing Pb, Te, Sn. The error of determining tellurium is ± 0.13, the error for lead is ± 0.70. (auth)

25226 USE OF FERROCENE IN PHOTOMETRIC DETERMINATION OF Mo IN AQUEOUS–ORGANIC MEDIA BY THE THIOCYANATE METHOD. Solomatin, V. T.; Yakovlev, P. Ya.; Lapshina, L. A.; Artemova, T. N. (Scientific-Research Inst. of Non-ferrous Metallurgy, Moscow). Zh. Anal. Khim.; 30: No. 1, 114-119(Jan 1975). (In Russian).

Ferrocene and organic solvents can be used in photometric determination of molybdenum by the thiocyanate method. Optimal conditions have been found for reducing Mo(VI) with ferrocene and formation of a thiocyanate complex in various acid aqueous–organic media. A procedure has been developed of photometric determining molybdenum in the presence of large amounts of Nb, W, Re, Zr and other elements. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 25345, 25950, 26214, 26220, and 26224.

25227 (BARC-755) ANALYSIS OF Zn, Zr, AND U IN THORIA BY X-RAY FLUORESCENCE SPECTROSCOPY. Dixit, R. M.; Kapoor, S. K. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1974. 11p. Dep. NTIS (US Sales Only) $4.00.

Zn, Zr, and U in thoria were determined at trace levels by an XRF method. Thoria samples, in the form of pressed pellets, are analyzed by Philips PW 1220 x-ray spectrometer. Instrumental parameters are selected to minimize the interferences. The average precision of the method is about ±12% and the lower limits of estimation of Zn, U, and Zr are 20, 50, and 100 ppM respectively. (auth)

25228 (Y-1457(Vol.1)) COLLECTIVE METHODS OF ANALYSIS OF ADDITIVES IN URANIUM METAL. Walden, G. E.; Steckel, L. M.; Barringer, R. E.; Warren, E. L.; Carden, W. F.; Dietrich, W. C.; Keys, J. H.; Sells, K. A. (Oak Ridge Y-12 Plant, Tenn. (USA)). 24 Apr 1964. Contract W-7405-eng-26. 87p. Dep. NTIS $7.50.

Declassified 15 Nov 1974.

A series of procedures have been developed and compiled in this report for the quantitative determination of trace amounts of elements in uranium. This series involves a total of seven different elements in a variety of combinations which call for procedure variations. These procedures were developed to meet needs arising during a period of one year (1961-62) and are treated in chronological order as each procedure was developed. All the procedures describe sample preparation, calibration conditions for measurement, and statistical evaluation. Each procedure has been written to be complete within itself and, thus, inevitably contains a repetition of much standard equipment and techniques. The result of the statistical evaluation is reported for each procedure. (auth)

25229 (Y-DA-125) DETERMINATION OF THE OXIDES OF NIOBIUM AND YTTRIUM IN LITHIUM HYDRIDE BY X-RAY FLUORESCENCE. Barringer, R. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 21 Jun 1962. 12p. Dep. NTIS $4.00.

Declassified 21 Nov 1974.

A step-by-step procedure for the x-ray fluorescence determination of the oxides of Nb and Y in LiH is given. Factors affecting the accuracy of the method were discussed. (JSR)

25230 TRITIUM IN FOODS. P. 3. Tritium Contents of Foods and Drinking Water. Mlinko, S.; Fischer, E.; Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (F.R. Germany). Inst. fuer Strahlentechnologie). Z. Anal. Chem.; 272: No. 4, 280-283(Dec 1974). (In German).

5 tabs.; 4 refs.

In order to test the method of tritium determination and to determine the tritium activity, foods of known origin were investigated. The accuracy of the method over a prolonged period of time was confirmed by the statistical evaluation of the background values and of the counting efficiency. An average value of 600 to 800 pCi of tritium in one liter of water was found in milk, potatoes, and apples. Drinking water contained very different activities of tritium, depending on its origin as ground or surface water. Food samples from the environment of nuclear reactors were not different in their tritium content when compared to those of other origins. (auth)

25231 PLUTONIUM-242 VS PLUTONIUM-236 AS AN ANALYTICAL TRACER. Kressin, I. K.; Moss, W. D.; Campbell, E. E.; Schulte, H. F. (Los Alamos Scientific Lab., NM). Health Phys.; 28: No. 1, 41-47(Jan 1975).

Plutonium-242 was compared to ^{236}Pu as a tracer isotope in the analysis of very low levels of ^{238}Pu and ^{239}Pu, and it was found that the ^{236}Pu tracer, because of its daughters, contributes to the background level for ^{238}Pu. This increased background becomes intolerable at the higher levels of the ^{236}Pu tracer because of the large variation in the background values. In contrast, the background values for ^{238}Pu and ^{239}Pu remain constant when ^{242}Pu is used as a tracer isotope in the analysis. Plutonium-242 solutions show no ingrowth of daughters whereas ^{236}Pu solutions require periodic purification and standardization to remove the ^{232}U and ^{228}Th daughters which interfere in the alpha spectrometry. (auth)

25232 PROCEDURE FOR DETERMINATION OF TRITIUM IN POTASSIUM. Forrester, R. C. III; Watson, J. S. (Oak Ridge National Lab., TN). Anal. Lett.; 8: No. 1, 63-70(Jan 1975).

A procedure has been developed for the quantitative analysis of potassium for its tritium content. This procedure consists of dissolving the highly reactive alkali metal in an inert liquid containing a small amount of ethanol and then analyzing the resulting solution for its tritium content by classical methods. Techniques previously used for sodium analysis are reviewed and discussed as they apply to the more reactive potassium. (auth)

25233 DETERMINATION OF FLUORINE IN WATER SAMPLES BY SPIKING ISOTOPE DILUTION AND ADSORPTION ON GLASS BEADS. van der Mark, W.; Das, H. A. (Reactor Centrum Nederland, Petten). J. Radioanal. Chem.; 23: No. 1-2, 7-16(1974).

A rapid method for the radiometric determination of fluoride concentration in aqueous solutions is presented. The method depends on the chemisorption of HF on a glass adsorber from a dilute acid solution, which has been spiked with ^{18}F. The limit of the determination is 0.03 μg/ml. Applications to surface water and urine samples are discussed. (auth)

25234 METHOD FOR MEASURING THE ACTIVITY OF NUCLIDES IN β SOURCES, DEPOSITED ON FOIL SUBSTRATES. Geidel'man, A. M.; Soloshenkov, P. S.; Fedotov, P. I.; Khol'nov, Yu. V. pp 30-35 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

A sandwich method was proposed for the measurement of the activity of the nuclides in β sources. A 4π proportional flowing gas counter filled with methane was used. The β source was deposited on a metallic foil (usually Al) and the counting rates in 2π geometry in the upper and lower halves of the 4π counter and the 4π counting rate were measured. The source was then covered with a foil of the same thickness as the substrate and the counting rate was again measured in 4π geometry. The source activity was then calculated from these measurements. The validity of the method was tested by measurement of the activity of ^{60}Co and ^{89}Sr. The results showed that the activity could be measured with an error no greater than 1%. (JSR)

25235 RAPID METHOD FOR THE DETERMINATION OF STRONTIUM-90 AND STRONTIUM-89 IN MILK. Gillard-Baruh, J. H. C. (Institut d'Hygiene et d'Epidemiologie, Brussels (Belgium)). Radiochim. Acta; 20: No. 1/2, 73-80(1973). (In French).

A quick method for the determination of ^{90}Sr and ^{89}Sr in milk is described, the object being to supply information in the shortest possible delay about environmental contamination following a nuclear accident. The milk cations are adsorbed on a Dowex cationic resin (batch method) and eluted by means of 4N nitric acid. Calcium, yttrium, and barium are then eliminated by means of well-known procedures and the pure strontium

obtained is mounted as a carbonate precipitate. ^{90}Sr and ^{89}Sr, being β-emitters of different energy are then discriminated by counting with aluminium absorbers. (auth)

25236 A METHOD AND DEVICE FOR THE AUTOMATED ANALYSIS OF THE RADIO-ACTIVITY OF A PLURALITY OF SAMPLES. Obrycki, R. F. (to Nuclear-Chicago Corp., Des Plaines, Ill. (USA)). French Patent 2177871/A/. 22 Mar 1973. Priority date 24 Mar 1972, USA. 17p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

An automated analysis procedure is described for the measurement of the radioactivity of samples containing a substance present at least in part in a radioactive form, but in variable quantity, and the device for carrying out this procedure is described. The basic characteristic of the procedure is that the radioactivity of the samples is compared to the radioactivity rate of a sample reference group containing the radioactive substance at the relative maximum concentration of the radioactive form. This apparatus and the procedure are designed particularly for measurements of the resistance of living cells to radioactive radiations. (tr-FR)

25237 EMPIRICAL METHOD OF CALCULATING X-RADIATION YIELD WITH α-RAY EXCITATION FOR MULTICOMPONENT SYSTEMS. Roessiger, V. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 11: No. 1, 13-16(Jan 1975). (In German).

The yield was calculated for targets of any given composition with characteristic x-radiation excited by α particles. The basic supposition of a linear excitation function (quantum source density) leading to a simple yield formula is justified by experiment. Two coefficients inherent in the apparatus shall be determined by measurement with regard to each element. These two constants determine the shape of the excitation function and may be considered as characterizing the operating range and the ionization cross section of the K-shell. (auth)

25238 ANALYSIS OF IRON IN BLOOD BY RADIOISOTOPE X-RAY FLUORESCENCE. Cesareo, R. (Instituto di Fisica, Rome); Del Principe, D.; Mancuso, G.; Tallarida, B. M. Isotopenpraxis; 11: No. 1, 16-18(Jan 1975).

This paper is intended to demonstrate how it is possible to carry out simple and economical analyses in blood using the radioisotope x-ray fluorescence technique. This method requires only 0.1 ml of blood deposited on a disk of filter paper. The iron content analysis requires about 10^3s, and the relative error is of about 1 to 3%. Utilization measurements of intramuscular injected iron have been carried out in a large number of anemic children. (auth)

25239 RADIORELEASE DETERMINATION OF THE CHEMICAL RESISTANCE OF POLYMETHYLMETHACRYLATE. Harangozo, M.; Naoum, M. M.; Tolgyessy, J.; Varga, S. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 20: No. 4-5, 295-298(28 Feb 1975).

A radiorelease method was developed to study the chemical resistance of polymethylmethacrylate. Kryptonated samples, prepared by polymerization kryptonation, were exposed to several chemical reagents (mineral acids and organic solvents) and the decrease in activity was followed as a function of time. (auth)

Separation Procedures

Refer also to abstracts 28682 and 28919.

25240 (NIM-1684) APPLICATION OF THREE-PHASE LIQUID–LIQUID EXTRACTION TO THE SEPARATION AND CONCENTRATION OF NOBLE METALS. Steele, T. W.; Nicolas, D. J. (National Inst. for Metallurgy, Johannesburg (South Africa)). 5 Dec 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

The procedure for a three-phase extraction system using the reagent diantipyrylmethane is described. The third phase, which is organic and of low volume, is formed beneath the normal organic phase of the conventional two-phase extraction system. The noble metals are extracted in the form of their thiocyanate complexes into the third phase from hydrochloric acid solutions. Platinum, palladium, ruthenium, and gold are extracted quantitatively, the extraction of rhodium is 9%, and iridium is not extracted. Nickel, aluminium, and chromium are not extracted to any extent, and iron and copper are coextracted. This procedure affords a rapid means for the concentration of the noble metals, which can subsequently be determined direct by conventional techniques. (auth)

25241 SORPTION OF IONS OF ALKALI METALS, COPPER (II), AND SILVER(I) FROM $MeF(CuF_2)-NaF(KF)-H_2O$ SOLUTIONS BY KU-2 × 88 CATION-EXCHANGE RESIN. Pakholkov, V. S.; Zelenkov, B. N. J. Appl. Chem. USSR (Engl. Transl.); 49: No. 9, 2002-2004(Sep 1974).

Translated from Zh. Prikl. Khim.; 47: No. 9, 1944-1947(Sep 1974).

Study of sorption of ions of the alkali metals, copper (II), and silver (I) from solutions of their fluorides by KU-2 × 8 cation-exchange resin in H^+ form in relation to the NaF and KF concentration showed that all the cations studied form the series $Li^+ < K^+ (Na^+) < Rb^+ < Cs^+ < Ag^+ < Cu^{2+}$ in order of sorbability, and of the influence of the NaF (or KF) concentration on it. Study of elution of Li^+, Na^+ (K^+), Rb^+, Cs^+, Ag^+, and Cu^{2+} ions from KU-2 × 8 resin by sodium and potassium fluoride solutions showed that lithium ions interact with NaF or KF in 0.3 to 1.0 N solutions to form a finely divided precipitate of lithium fluoride, which remains in the pores of the resin grains. (auth)

25242 RADIOPOLAROGRAPHY. P. 2. An Experimental Survey of Precision and Accuracy. Miranda, C. F.; Muxart, R.; Zuppiroli, G. (Fondation Curie-Institut du Radium, 94–Arcueil (France). Lab. d'Arcueil). Radiochim. Acta; 20: No. 1/2, 11-20 (1973).

A comparative study of radiopolarographic techniques was carried out. None was found simultaneously precise and accurate but a choice meeting one of these requirements is possible. Carbon tetrachloride can interfere with polarographic reductions; tricresyl phosphate constitutes a better alternative in Love's method. Encouraging preliminary results were obtained with Leonhardt's cell, which avoids the use of an insulating phase. (auth)

25243 SOLVENT EXTRACTION OF ZINC-THIOCYANATE COMPLEXES FROM MOLTEN $LiNO_3-NH_4NO_3$ EUTECTIC. Sipos, M. (Inst. of Isotopes, Budapest). Radiochem. Radioanal. Lett.; 20: No. 4-5, 323-330(28 Feb 1975).

The distribution of zinc between molten lithium nitrate–ammonium nitrate eutectic containing variable amounts of ammonium thiocyanate-potassium thiocyanate eutectic and the liquid anion exchanger Amberlite LA-2 has been studied. From the experimental data the formation constants of negatively charged thiocyanato-complexes of zinc have been calculated. (auth)

25244 SEPARATION OF Al, Fe, AND La IN THE FORM OF HYDROXIDES FROM Cu, Zn, Cd, Co, AND Ni AND ESTIMATION OF SORPTION AFFINITY DURING COPRECIPITATION IN SUCH SYSTEMS. Teodorovich, I. L. (Inst. of Chemistry, Tashkent). Zh. Anal. Khim.; 30: No. 1, 14-21(Jan 1975). (In Russian).

Separation of $M^{2+} - M^{3+}$ pairs ($M^{2+} - Cu^{2+}$, Zn^{2+}, Cd^{2+}, Co^{2+}, Ni^{2+}; $M^{3+} - Al^{3+}$, Fe^{3+}, La^{3+}) has been studied in alkaline media in the presence of complex-forming reagents: ammonia, glycine (Gl), and ethylenediamine (EDA). Semiquantitative estimation is given of bond strength in $M^{2+} - M(OH)_3$ systems from (i) the degree of coprecipitation of M^{2+} with $M(OH)_3$; (ii) the change in free energy (ΔF) during decomposition of complexes of M^{2+} with ammonia, Gl, and EDA; (iii) the degree of coprecipitation of M^{2+} in the $M(OH)_3$ volume. A tendency to form most stable bonds (affinity) is observed in systems involving Zn^{2+}, Cd^{2+}, and Co^{2+}; this tendency for the collectors follows the order: $Fe(OH)_3 > Al(OH)_3 > La(OH)_3$. The regularities found have made it possible to determine optimal conditions for separation of $M^{2+} - M^{3+}$ pairs. The data obtained have been used to develop electrochemical procedures of quantitative determination of some M^{2+} and M^{3+} ions. (auth)

25245 SORPTION OF METAL IONS BY SULFONATED CATION EXCHANGERS FROM ORTHOPHOSPHORIC ACID SOLUTIONS. Filatova, L. N.; Kurdyumova, T. N.; Shelyakina, M. A. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 9, 2160-2161(Sep 1974).

Translated from Zh. Prikl. Khim.; 47: No. 9, 2106-2107(Sep 1974).

Sorption of metal ions was studied under static conditions with the aid of ^{45}Ca, ^{91}Y, and ^{26}Al. The data show that the use of phosphoric acid solutions may prove effective not only for separating certain bivalent metals from iron, but also for separating such elements as scandium and lanthanum or scandium and yttrium. Addition of alcohol has little effect on the selectivity of separation of trivalent metals, but sharply raises the distribution coefficients of uni- and bivalent cations, which undoubtedly improves the effectiveness of their separation from H_3PO_4. (LK)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 25274.

Chemical and Physicochemical Properties

Refer also to abstracts 25320 and 26472.

25246 (CEA-CONF-2715) COMPARISON OF THE PROPERTIES OF 5f, 4d, AND 5d ELEMENTS WITH V, VI, AND VII DEGREES OF OXIDATION. Musikas, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). [nd]. 10p. (In French). (CONF-740583-1). Dep. NTIS (US Sales Only) $4.00.

From advanced radiochemistry seminar; Paris, France (16 May 1974).

The chemical properties of the halogenides and binary oxides of the 5f, 4d, and 5d elements are briefly compared and illustrated. The chemical differences in the d and f elements are more pronounced in aqueous solutions. These differences are illustrated in a discussion of the behavior of the oxides. (JSR)

25247 (CONF-740491-(Absts.)) [CONFERENCE ON] CHEMICAL KINETICS IN SHOCK TUBES, UNIVERSITY OF SOUTHAMPTON, 8TH–10TH APRIL 1974. Summaries of Contributions. (Southampton Univ. (UK)). 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

25248 (UCRL-51674) ESTIMATED INFRARED SPECTRA OF CRYOGENIC D_2-DT-T_2. Souers, P. C.; Hickman, R. G.; Wade, W. Z.; Tsugawa, R. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jan 1975. Contract W-7405-eng-48. 14p. Dep. NTIS $4.00.

The literature on the fundamental infrared vibration-rotation spectra of cryogenic H_2, HD, and D_2 is reviewed. The assignments of the most basic spectral lines are given relative to the vibrational and rotational energy levels. Emphasis is given to changes of spectral appearance upon liquefaction and freezing. Using simple models, the vibrational and rotational splittings of DT and T_2 are calculated. All data is used to estimate the spectrum of D_2-DT-T_2 liquid at the triple-line temperature of 19.75K. It is seen that quantitative analysis of the three components may be carried out, as well as measurement of the ortho-para transition rates. The chemical equilibrium rates are probably not measurable, however, unless liquid D_2 and T_2 are actually mixed. Similar information should be available from the spectrum of the solid; however, the chemical-equilibrium constant has not been calculated at low temperatures. Induced infrared appears most promising as a tool for phase-diagram studies of the cryogenic system D_2-DT-T_2. (auth)

Isotope Effects

Refer also to abstracts 25289, 25292, 25293, and 25300.

25249 THE ISOTOPE EFFECT OF THE IMPURITY DIFFUSION IN ELECTROTRANSPORT. Herzig, C. (Muenster Univ. (F.R. Germany). Inst. fuer Metallforschung). Appl. Phys.; 3: No. 5, 433-434(May 1974).

11 refs.

Determining the isotope effect of impurity diffusion in an electrotransport experiment under steady state conditions permits the evaluation of the effective charge of the impurity. In addition, the intrinsic diffusion coefficient of the solvent can be determined, which allows the vacancy flow factor to be found. Making use of other diffusion data it is then possible to calculate atomic jump frequency ratios in the neighborhood of a vacancy. (auth)

25250 THE REACTION OF HYDROGEN ATOMS WITH SILANE; ARRHENIUS-PARAMETERS AND KINETIC ISOTOPE EFFECT. Potzinger, P.; Glasgow, L. C.; Reimann, B. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr (F.R. Germany). Abt. fuer Strahlenchemie). Z. Naturforsch., 29A: No. 3, 493-496(Mar 1974). (In German).

2 figs.; 1 tab.; 16 refs.

Relative rate constants were measured for the systems H + C_2H_4/SiD_4 and D + C_2D_4/SiH_4 over a wide temperature range. From the known Arrhenius parameter for the reaction H + C_2H_4 the activation energy E_A and the pre-exponential factor A of the abstraction reaction H + $SiD_4 \rightarrow$ HD + SiD_3 may be calculated. Values of E_A = 3.2 kcal/mol and A = 4.92×10^{13} cm^3 mol^{-1} sec^{-1} were obtained. Upper limits for the kinetic isotope effects are given in the paper. (auth)

25251 THERMODYNAMICS OF TRANSFER OF NONELECTROLYTES FROM LIGHT TO HEAVY WATER. I. Linear Free Energy Correlations of Free Energy of Transfer with Solubility and Heat of Melting of a Nonelectrolyte. Vesala, A. (Univ., Turku). Acta Chem. Scand.; 28: No. 8, 839-845(1974).

The solubilities of twenty-four slightly soluble nonelectrolytes were measured in light and heavy water. From these solubility values the changes in the standard free energy of transfer from H_2O to D_2O could be calculated for all compounds at 298.15°K. The determined transfer free energies are generally rather small in magnitude and positive in sign. They are, however, significant having a standard error less than 10%. A satisfactory linear free energy correlation was obtained between the free energy of transfer of nonelectrolytes from H_2O to D_2O and the free energy of transfer of the corresponding nonelectrolytes from the gas phase to the hypothetical one aquamolal solution in H_2O. In addition, a linear correlation was found between the free energy of transfer from H_2O to D_2O and the heat of melting at the melting point of the various compounds. (auth)

25252 SPECTROSCOPIC INVESTIGATION OF SOME SPHERICAL MOLECULES $X(YR)_4$ (X = C, Si, Ge, Sn; Y = O, S AND R = METHYL, ETHYL, ISOPROPYL) AND OF $(CH_3)_2S$, CH_3SCD_3, $(CD_3)_2S$, AND $(CH_3)_3SBr$. Ypenburg, J. W. Amsterdam; Univ. of Amsterdam (1971). vp. Available from the Library of the Univ. of Amsterdam, Netherlands.

Thesis (Ph. D.).

The vibrational spectra (Raman and infrared) of $(CH_3)_2S$, CH_3SCD_3, $(CD_3)_2S$, $(CH_3)_3SBr$, $C(OCH_3)_4$, $C(OC_2H_5)_4$, $Si(OCH_3)_4$, $Si(OC_2H_5)_4$, $C(SCH_3)_4$, $C(SC_2H_5)_4$, $Si(SCH_3)_4$, $Ge(SCH_3)_4$ and $Sn(SCH_3)_4$ were recorded and analyzed with an assignment of the frequencies observed. The vibrational spectrum of $C[SCH(CH_3)_2]_4$ was obtained also. The eigenvalue problem of the three compounds mentioned first has been dealt with. Redundancy relations are derived to second order. A set of force constants that reproduces the eigenvalues, has been derived. The skeleton $X(YC)_4$ of the molecules $C(OCH_3)_4$, $C(SCH_3)_4$, $Si(SCH_3)_4$ and $Ge(SCH_3)_4$ may have S_4 or D_{2d} symmetry in the equilibrium state. It may be inferred from the temperature dependence of the intensity ratios of specific Raman lines in the liquids and from approximate calculations with the aid of the Lennard–Jones potential for methane that the S_4 configurations of $C(SCH_3)_4$ and $C(OCH_3)_4$ are ~2 and ~1 kcal/mole more stable than the corresponding D_{2d} configurations, respectively. Solid $C(OCH_3)_4$ contains only molecules with D_{2d} configuration. Solid modification 1 of $C(SCH_3)_4$ which is stable at temperatures below 23°, contains only the D_{2d} configuration; modification 2, stable between 23 and 46°, contains only the S_4 configuration and modification 3, stable between 46° and the melting point, consists of a mixture of both configurations. The remarkable sequence: in 1 D_{2d} only, in 2 S_4 only, in a 3 mixture of D_{2d} and S_4 is accompanied by an increase of rotational freedom at rising temperature, as may be inferred from an increase of the volume at both transitions. The entropy gain due to increasing freedom of internal rotation is probably the most important factor of the alterations in the free enthalpy at the transitions in the solid state. Solid $Si(SCH_3)_4$ and $Ge(SCH_3)_4$ contain at −160° only one modification. The liquid phases of $C(OCH_3)_4$, $C(SCH_3)_4$, $Si(SCH_3)_4$ and $Ge(SCH_3)_4$ consist of a mixture of both configurations S_4 and D_{2d}. There is no distinction between both configurations in $Si(OCH_3)_4$ as the rotation of OCH_3 groups around their SiO axes is apparently practically free. The methyl group of an YC_2H_5 group in $X(YC_2H_5)_4$ may occupy a gauche or a trans position relative to its XY bond. Rotational isomery of this kind is probably present in $C(OC_2H_5)_4$ and $C(SC_2H_5)_4$. Raman spectra of solid $C(SC_2H_5)_4$ at temperatures above and below the transition point at −94°C are identical within measuring errors. Rotational isomery is probably absent in $Si(OC_2H_5)_4$. (Diss. Abstr. Int., B)

25253 RADICAL PRODUCTION FROM THE INTERACTION OF CLOSED SHELL MOLECULES. III. An Isotope Effect Test for Distinguishing SN2 from Electron Transfer (ET) Reactions. Pryor, W. A.; Hendrickson, W. H. Jr. (Louisiana State Univ., Baton Rouge). J. Amer. Chem. Soc.; 97: No. 6, 1582-1583 (19 Mar 1975).

Data are presented to show that in the reaction of nucleophiles with peroxides an inverse isotope effect is observed for SN2 reactions, whereas in electron transfer reactions the isotope effects are normal. (JSR)

25254 KINETIC STUDY OF GENERAL AND SPECIFIC CATALYSIS OF HYDROLYSIS OF PARA-SUBSTITUTED N-BENZOYLIMIDAZOLES AND OF N-ACETYLIMIDAZOLE IN IMIDAZOLE BUFFERS. Palaitis, W.; Thornton, E. R. (Univ. of Pennsylvania, Philadelphia). J. Amer. Chem. Soc.; 97: No. 5, 1193-1196(5 Mar 1975).

Rates of hydrolysis of p-nitrobenzoylimidazole have been measured in H_2O and D_2O imidazole buffers, and rates of hydrolysis of p-chloro- and p-methylbenzoylimidazole and acetylimidazole have been measured in H_2O imidazole buffers at 25°, ionic strength = 0.5 M. Rate terms and isotope effects were obtained with very good precision for water, lyoxide, lyonium ion, and imidazole catalysis. A term for imidazolium ion catalysis was shown to be present for acetylimidazole and probably for p-methylbenzoylimidazole substrates. Hammett p values, followed

by the p-nitrobenzoylimidazole D_2O solvent isotope effects, k_H/k_D, for the various catalytic terms are as follows: k_0, 1.414 ± 0.002, 2.36 ± 0.05; k_{LO^-}, 1.47 ± 0.08, $(1.03 \pm 0.02)^{-1}$; $k_{L_2O^+}$, 1.00 ± 0.03, $(1.33 \pm 0.04)^{-1}$; k_{GB}, 1.24 ± 0.03, 2.83 ± 0.04. It is concluded that these reactions probably all involve general-base catalyzed rate-determining nucleophilic attack by water at the carbonyl carbon atom by an unusual mechanism in which the proton does not appear to move in the reaction coordinate motion (imaginary vibration) of the transition state including the imidazole catalysis term not previously correlated with the other terms. It is also shown that the term for imidazolium ion catalysis actually involves the kinetically equivalent imidazole general-base catalysis of hydrolysis of acetylimidazolium ion. (auth)

25255 VALENCE ISOMERIZATION OF HOMOCUBANES. Reversible Complex Formation and Kinetic Substituent Effects Operating During Silver(I)-induced Bond Reorganization. Paquette, L. A.; Ward, J. S.; Boggs, R. A.; Farnham, W. B. (Ohio State Univ., Columbus). J. Amer. Chem. Soc.; 97: No. 5, 1101-1112 (5 Mar 1975).

To probe the effect of such groups as phenyl, vinyl, cyclopropyl, and ethoxy on the rate of Ag^+-catalyzed homocubyl rearrangements, the isomerizations of 4-substituted homocubanes were compared with those of model compounds where direct resonance interaction in the transition state was not anticipated. In contrast to the kinetic behavior of homocubane and its 4-CH_3, 4-CH_2OAc, 4-$COOCH_3$, and 4-CH_2OCH_3 derivatives which conform to a linear σ^* free energy relationship ($\rho^* = -2.33$), the first four compounds isomerize more rapidly than expected on this basis. The 4-tert-butyl substituent affects bond switching by a steric parameter and the k_{Ag} in this instance is smaller than projected. Placement of a deuterium atom or a CD_3 group at C_4 gives rise to a small inverse kinetic deuterium isotope effect ($k_H/k_D = 0.97$) in each instance. Introduction of a second substituent at C_5 does not lead to acceleration of the bond switching process. The contributions of C_5 substitution to the overall isomerization rate have also received limited scrutiny. All of these catalyzed reactions follow a second-order rate dependence with incursion of preequilibrium complex formation. Adherence to Michaelis–Menten kinetics was demonstrated for 4-methylhomocubane. Several synthetic approaches were devised for the preparation of the various homocubanes and these are detailed. The rearrangements produce norsnoutanes exclusively and in essentially quantitative yield. On the basis of these diverse findings, the bond switchings appear to proceed by Ag^+-induced electrophilic ring opening of the less substituted edge bonds. Solvolytic reactions of cyclopropylcarbinyl and cyclobutyl derivatives serve as mechanistic prototypes. (auth)

25256 DEUTERIUM EFFECT ON LIFETIME OF URANYL COMPLEXES IN SOLUTIONS. Joshi, G. C.; Tripathi, H. B.; Pant, D. D. (Deb Singh Bisht Government Coll., Nainital, India). Curr. Sci. (India); 44: No. 6, 185-186(20 Mar 1975).

The lifetimes of difference uranyl complexes in various protonated solutions and their deuterated counterparts were measured at 80°K. Although the lifetimes of all uranyl complexes studied were increased in deuterated solvents, the effect was quite large in aqueous solutions of the nitrate and perchlorate. Only a slight increase was noted for complexes such as $UO_2(NO_3)_2$ in acidic solution or for hydrolyzed complexes. The mechanism responsible for this difference in the deuterium effect was discussed. (JSR)

25257 REACTION OF C_2H^+ WITH H_2. Smith, G.P.K.; Carlson, R.D.; Cross, R.J. Jr. (Department of Chemistry, Yale University, New Haven, Connecticut 06520). J. Chem. Phys. 62: No. 5, 1999-2000 (1 Mar 1975).

Using a crossed beam technique, the product angular and velocity distributions have been measured for the reaction of C_2H^+ with D_2 and the reaction of C_2D^+ with H_2. The case where the product is the acetylene ion is discussed and reaction mechanisms are proposed. (AIP)

25258 RAMAN SPECTRA AND RING PUCKERING OF SILACYCLOBUTANE–d_0 AND –1,1–d_2 AND SILACYCLOPENT–3–ENE. Lewis, J.D.; Chao, T.H.; Laane, J. (Department of Chemistry, Texas A&M University, College Station, Texas 77843). J. Chem. Phys. 62: No. 5, 1932-1935 (1 Mar 1975).

Vapor–phase Raman spectra have been recorded for three cyclic organosilane molecules. Ten $\Delta v=2$ transitions were observed between 90 and 180 cm^{-1} for silacyclobutane; seven were recorded for silacyclobutane–1,1–d_2. The undeuterated compound also shows a difference band series in the CH_2 stretching region. For silacyclopent–3–ene a difference band series originating from an olefinic C–H stretching mode was recorded. All the spectra confirm previous assignments of far–infrared spectra. (auth)

25259 MICROWAVE SPECTRUM AND STRUCTURE OF CYCLOPROPENE. Stigliani, W.M.; Laurie, V.W.; Li, J.C. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). J. Chem. Phys. 62: No. 5, 1890-1892 (1 Mar 1975).

The microwave spectrum of cyclopropene has been investigated in the region of 18–40 GHz. The two monosubstituted ^{13}C species have been assigned and a centrifugal distortion analysis carried out on the main isotopic species. Structural parameters obtained are r (C_1C_2) = 1.509±0.001 Å, r ($C_2C_{2'}$) = 1.2959±0.0004 Å, $\angle C_2C_1C_{2'}$ = 50.84±0.05°, r (CH ethylenic) = 1.072±0.001 Å, r (CH methylenic) = 1.088±0.002 Å, $\angle C_2C_2H$ = 149.85±0.08°, $\angle HC_1H$ = 114.57±0.19°. (auth)

25260 TEMPORARY NEGATIVE IONS AND ELECTRON AFFINITIES OF BENZENE AND *N*–HETEROCYCLIC MOLECULES: PYRIDINE, PYRIDAZINE, PYRIMIDINE, PYRAZINE, AND *s*–TRIAZINE. Nenner, I.; Schulz, G.J. (Department of Engineering and Applied Science, Mason Laboratory, Yale University, New Haven, Connecticut 06520). J. Chem. Phys. 62: No. 5, 1747-1758 (1 Mar 1975).

Electron transmission spectroscopy is used to study shape resonances (temporary negative ions) in benzene and some isolectronic *N*–heterocyclic molecules (pyridine, diazines, and *s*–triazine), in the energy range 0–6 eV. The lowest shape resonance in each of these molecules exhibits vibrational structure which is interpreted in all cases as the totally symmetric *C–C* stretch mode. The ground vibrational level of this lowest shape resonance is accessible by electron impact only in benzene and pyridine. Thus, their electron affinities can be determined from the present experiment (–1.15 eV for C_6D_6 and –0.62 eV for C_5H_5N). Only excited vibrational levels are accessible in the diazines and *s*–triazine, indicating that the electron affinities for these molecules have positive values. For benzene, pyridine, and some other aromatic hydrocarbons, we compare the electron affinities established in the gas phase with the polarographic potentials established in the liquid phase and we find a linear relationship. Using this correlation in conjunction with the measured values of the polarographic potentials, we estimate the electron affinities for pyridazine (0.25 eV), pyrimidine (0 eV), pyrazine (0.40 eV) and *s*–triazine (0.45 eV). (auth)

25261 INTERPRETATION OF THE VAPOR PRESSURE ISOTOPE EFFECT OF BCl_3. Jancso, G. (Magyar Tudomanyos Akademia, Budapest. Kozponti Fizikai Kutato Intezet). Ber. Bunsenges. Phys. Chem.; 78: No. 7, 648-651(Jul 1974).

The available experimental data on the vapour pressure isotope effect (VPIE) of BCl_3 are interpreted in the light of the theory of isotope effects in condensed systems. It is shown that the temperature dependence of the VPIE of $^{10}BCl_3/^{11}BCl_3$ observed by Rayleigh distillation is of the wrong sign. The measured normal VPIE for $B^{35}Cl_3/B^{37}Cl_3$ is in satisfactory agreement with that obtained by the model calculation. (auth)

25262 SOLVENT ISOTOPE EFFECT OF PYRUVIC ACID HYDRATION. Menzel, H. M. (Max-Planck-Institut fuer Biophysikalische Chemie (Karl-Friedrich-Bonhoeffer-Institut), Goettingen (F. R. Germany)). Ber. Bunsenges. Phys. Chem.; 78: No. 1, 89-93(Jan 1974).

The solvent isotope effect on the hydration constant, the dissociation constant and the rate constants for the uncatalyzed and specific acid catalyzed dehydration of pyruvic acid was investigated. The pK of the dissociation constant of the ketoacid is by 0.29 smaller in H_2O than in D_2O. The ratio of the hydration constant of undissociated pyruvic acid (K_{H_2O}/K_{D_2O}) is 0.83, while the ratio of the rate constant of dehydration is 2.65 for the uncatalyzed reaction and 1.33 for lyonium ion catalysis. The results are discussed in terms of the possibility of intramolecular hydrogen bonding. (auth)

25263 SPECIFIC RATE CONSTANTS OF UNIMOLECULAR PROCESSES. P. 2. Adiabatic Channel Model. Quack, M.; Troe, J. (Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Chimie Physique). Ber. Bunsenges. Phys. Chem.; 78: No. 3, 240-252(Mar 1974).

With appendix.

The rate of unimolecular processes is calculated by means of a statistical adiabatic channel model. The rates are mainly determined by the maxima of the channel energies. The channels are constructed by correlating reactant and product states; the channel energies are computed by a simple interpolation procedure. The coupling between the various vibrational-rotational motions is taken into account. The influence of parameters of the potential surface on channel energies and on rate constants is studied. Numerical results for the NO_2, CH_4, CD_4, C_2H_6 and C_2D_6 dissociation-recombination kinetics are compared to experimental data. The statistical adiabatic channel model gives similar results as minimum local entropy models. Both these approaches lead to stronger curvatures of k(E) and smaller activation energies for the thermal rate constant k infinitely than the corresponding RRKM calculations. (auth)

Isotope Exchange and Isotope Separation

25264 APPARATUS FOR THE PRODUCTION OF HIGH ISOTOPIC PURITY DEUTERIUM. Persky, A.; Kuppermann, A. (California Inst. of Tech., Pasadena). J. Phys., E (London); 7: No. 11, 889-890(Nov 1974).

An apparatus for the electrolytic preparation of high purity D_2 is described. D_2 with isotopic purity exceeding 99.98% (atomic percentage) was obtained with this apparatus by electrolyzing D_2O (99.8% isotopic purity) down to about 30% of its original volume. (auth)

25265 CATALYSED HYDROGEN ISOTOPE EXCHANGE. (to University of New South Wales). Australian Patent 73-54805. 19 Apr 1973. 22p.

A method is described for enhancing the rate of exchange of hydrogen atoms in organic compounds or moieties with deuterium or tritium atoms. It comprises reacting the organic compound or moiety and a compound which is the source of deuterium or tritium in the presence of a catalyst consisting of a non-metallic, metallic, or organometallic halide of Lewis acid character and which is reactive towards water, hydrogen halides or similar protonic acids. The catalyst is a halide or organometallic halide of: (i) zinc or another element of Group IIb; (ii) boron, aluminium or another element of Group III; (iii) tin, lead, antimony or another element of Groups IV to VI; or (iv) a transition metal, lanthanide or stable actinide; or a halchalide. (auth)

25266 KINETICS AND MECHANISM OF H_2-D_2 EXCHANGE CATALYZED BY HYDRIDOCHLOROTRIS(TRIPHENYLPHOSPHINE) RUTHENIUM(II). Strathdee, G.; Given, R. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Can. J. Chem.; 53: No. 1, 106-113(1 Jan 1975).

The H_2-D_2 exchange reaction is catalyzed extremely efficiently by solutions of hydridochlorotris(triphenylphosphine)ruthenium(II) in benzene between 279 and 298°K. Rates of exchange were partly controlled by the mass transport of hydrogen. A mechanism involving formation of di- and tetrahydride ruthenium species has been employed to explain the rapid H-D exchange without the participation of the original Ru-H bond of $RuHCl(PPh_3)_3$. Nuclear magnetic resonance and infrared experiments showed that the rate of exchange of Ru-H with D_2 was insignificant with respect to the rate of the H_2-D_2 equilibration process. (auth)

25267 DISTRIBUTION OF STABLE ISOTOPES OVER AN INFINITELY LONG FISSION TUBE WITH AN INFINITELY BIG RESERVOIR AT ITS END IN STATIONARY STATE. Lyubimov, V. N. (Inst. of Organic Chemistry, Novosibirsk, USSR). Isotopenpraxis; 11: No. 1, 25-29(Jan 1975). (In Russian).

With the aid of a digital computer the distribution curves of the isotope concentration of 17 elements have been calculated along an infinite separation tube with an infinitely large reservoir on the end in the steady state. The plots of the distribution curves are adduced for the polyisotopic elements. The extremal points of the curves are listed in the table. The distribution curves features are determined in the first instance by the initial isotopic composition of the element to be separated. (auth)

25268 ALKYL HYDROGEN REACTIVITY OF 1-AMINO-5-METHYL-HEXANE IN EXCHANGE REACTION WITH SULFURIC ACID. Egyed, J.; Ruffilli, L. (Central Research Inst. for Chemistry, Budapest). Radiochem. Radioanal. Lett.; 20: No. 4-5, 251-254(28 Feb 1975).

The hydrogen exchange between the alkyl hydrogens of 1-amino-5-methylhexane and concentrated sulfuric acid was followed by isotope techniques using derivatives labelled with tritium at various positions. It has been established that tritium atoms attached to carbon atoms 4 and 6, respectively, tend to exchange at identical rates in sulfuric acid, with activation enthalpies of 13.79 and 14.36 kcal/mol, respectively. The tertiary tritium (i.e., the one attached to carbon atom 5) proved to be incapable of exchange. (auth)

25269 INVESTIGATION OF THE KINETICS OF ACYL GROUP EXCHANGE. III. Dutka, F.; Marton, A. F.; Komives, T. (Central Research Inst. for Chemistry, Budapest). Radiochem. Radioanal. Lett.; 20: No. 4-5, 263-271(28 Feb 1975).

Acyl group exchange of substituted phenyl acetates with acetic-1-^{14}C acid catalyzed by pyridine in different solvents was followed kinetically. Structure-reactivity relationships and reaction pathway for acyl exchange with acetic acid and acetic anhydride as well as for acetate catalyzed hydrolysis of substituted phenyl acetates are comparatively discussed. (auth)

Feed Materials Processing

25270 (RFP-TRANS-165) PREPARATION OF UF_4 BY ELECTROLYTIC REDUCTION. (Junta de Energia Nuclear, Madrid (Spain)). [nd]. Translation of JEN-278. 40p.

Laboratory scale studies on the preparation of nuclear grade UF_4 by electrolytic reduction of acid solutions of uranyl sulfate are reported. The study of the electrolytic cell was approached from the aspect of materials testing, study of the electrolyte, optimum value of current density, and cell geometry. Complementary studies were made on sedimentation, washing and recovery, and drying and dehydration. A pilot plant was constructed on the basis of the laboratory tests. Its performance in electrolytic reduction and preparation of UF_4 is briefly described. (JSR)

25271 FROM URANIUM MINERALS TO FINISHED NUCLEAR FUELS. Blum, J. M.; Boutonnet, G.; Joly, F.; Tachon, O. (Ugine-Kuhlmann, 75-Paris (France)). Kerntechnik; 16: No. 11, 470-474(Nov 1974). (In German, English).

The current status of the French nuclear fuel industry is reviewed in the following areas: uranium extraction and production of concentrates; conversion to uranium hexafluoride; fabrication of finished nuclear fuels. The two other parts of the fuel cycle, i.e., isotopic enrichment and reprocessing, are not discussed. (auth)

Radiation Chemistry

Refer also to abstracts 25765, 25981, 25982, 25994, and 28356.

25272 (AD-734848) GAMMA RADIOLYSIS OF TERTIARY AROMATIC AMINES. Final Technical Report. Khandelwal, G. D.; Swan, G. A. (Newcastle Upon Tyne Univ. (UK). Dept. of Organic Chemistry). 31 Oct 1971. Contract DAJA37-70-C-0234. 19p. NTIS $3.00.

Earlier research on the gamma-radiolysis of tertiary aromatic amines such as N,N-dimethylaniline has been extended to amines in which beta hydrogen is present e.g., 1-phenylpyrrolidine, 1-phenylpiperidine and N,N-diethylaniline. Unlike the N-methyl compounds, these latter yield dimeric products which are not formed by simple radical coupling. The action of t-butoxy radicals on tertiary aromatic amines sometimes leads to the same products as does gamma radiolysis. However, the action of t-butoxy radicals on N,N-dimethylaniline in chlorobenzene is complicated. Research on the formation of quinoline derivatives by radiolysis of N,N-dimethylaniline in the presence of N-phenylmaleimide has been extended by the use of diethyl maleate in place of N-phenylmaleimide. (auth)

25273 (AD-753652) GAMMA RADIOLYSIS OF TERTIARY AROMATIC AMINES. Final Technical Report, 1 October 1971-30 September 1972. Khandelwal, G. D.; Swan, G. A. (Newcastle Upon Tyne Univ. (UK). Dept. of Organic Chemistry). Oct 1972. Contract DAJA37-72-C-1546. 14p. NTIS $3.00.

Earlier research on the gamma radiolysis of 1-phenylpiperidine has been extended to give evidence of the formation of the enamine 1-phenyl-2-piperidine as an intermediate. Thus, irradiation of the amine in the presence of N-phenylmaleimide yields 1,2,3,4,5,6-hexahydro-4aH-benzo(c)quinolizine-5-6-N-phenyldicarboximide; but if the amine is first irradiated in the pure state, and subsequently treated with N-phenylmaleimide, an isomeric product is obtained. Gamma radiolysis of, or reaction of t-butoxy radicals with 1-phenylhexahydroazepine yields the radical coupling dimer 1,1'diphenyldodecahydro-2,2'-biazepine. A number of 2-arylhexahydroisoindolines and 2-p-tolyloctahydrocyclopenta (c)pyrole were also prepared. Reaction of compounds with t-butoxy radicals afforded dimeric products analogous to one obtained from 1-phenylpyrrolidine. (GRA)

25274 (AEC-tr-7422/9) NUKLEONIKA. Translation of Nukleonika; 18: No. 9, 383-438(1973). 54p. (TT-73-54035/9). Dep. NTIS $5.75.

25275 (AEC-tr-7422/11) NUKLEONIKA. Translated from Nukleonika; 18: No. 11, 501-576(1973). 69p. (TT-73-54035/11). Dep. NTIS $5.45.

25276 (AED-CONF-74-509-015) MEASUREMENT OF THE W-VALUE OF LOW ENERGY ELECTRONS. Waker, A. J.; Booz, J. 1974. 11p. INIS.

From second symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

With abstract. Available from ZAED.

The W-value (mean energy required to form on ion pair) of low energy electrons between 16 eV and 5 keV was measured for methane and the tissue-equivalent gas (T. E. gas) of Rossi and Failla. For high energies (approximately 5 keV) W-values were observed of 27.2 eV for methane and 29.4 eV for T. E. gas. At lower energies the W-values were found to increase; in addition there was seen a relative maximum of the W-value at about 300 eV for methane and between 500-600 eV for T. E. gas. The differential W-value, $\omega = dE/dN$, evaluated from W (E) curves,

has corresponding peaks between 250 and 300 eV for both gases. The peak of the T. E. gas curve is, however, asymmetric, extending to higher energies. This asymmetry could be explained by a second peak of minor height at about 500 eV. It is not impossible, therefore, that these peaks are related to the binding energy of the K-shell electrons of the various atoms comprising the gas molecules. Both curves of ω as a function of energy show a second peak at about 30 eV. A comparison was made with other measurements of W for electrons and photons and the difference between the measured W-values of photons and electrons is discussed. (GE)

25277 (CEA-CONF-2752) ENDOR IDENTIFICATION OF A $R-RH_2$ RADICAL IN GAMMA IRRADIATED ANTIFERROELECTRIC $NH_4H_2AsO_4$ SINGLE CRYSTALS. Lamotte, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1974. 4p. (CONF-740942-2). Dep. NTIS (US Sales Only) $4.00.

From 18th ampere congress; Nottingham, UK (9 Sep 1974).

Identification is made, by ENDOR at 1.5°K, of a free radical species, created by gamma irradiation at room temperature of crystals of $NH_4H_2AsO_4$, whose EPR lines lie around g = 2, and which shows hyperfine interactions with two nearly equivalent protons and one nitrogen. The radical, called $R-NH_2$, is of the π type character on the NH_2 fragment, and the spin density in the nitrogen $2p_\pi$ orbital is about 0.6. (auth)

25278 (EUR-5126d/e/f/i/n) INTERNATIONAL COLLOQUIUM, THE IDENTIFICATION OF IRRADIATED FOODSTUFFS, KARLSRUHE, 24-25 OCTOBER 1973. (Commission of the European Communities, Luxembourg; Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (F. R. Germany)). 1974. 361p. (In Several Languages). (CONF-731079-). EUR FB 1200,-.

The 32 papers presented at the Conference were compiled. Separate abstracts were prepared for 11 papers. Abstracts of the other papers have previously appeared in NSA. For these abstracts see abstracts 15865, 15866, 21130, 21135, 18146, 18159, 18176, 18184, 18185, 18186, 18187, 18550, 18552, 18553, 18515, and 15864 in Vol. 29 and 06872 and 14929 in Vol. 30. (JSR)

For abstracts of individual papers see: 25279–25287, 25981, and 25982.

25279 (EUR-5126d/e/f/i/n, pp 27-44) IDENTIFICATION OF IRRADIATED MEAT USING THIN-LAYER GEL CHROMATOGRAPHY AND THIN-LAYER ISOELECTRIC FOCUSSING. Radola, B. J. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe). 1974. (In German).

In international colloquium, the identification of irradiated foodstuffs.

A new, radiation-induced fraction can be shown to exist in sarcoplasm proteins of meat irradiated in the dose range of 1 to 5 Mrad, using thin-layer gel chromatography on Sephadex G-200. The radiation-induced fraction moves faster than all fractions of the sarcoplasm proteins of unirradiated meat and can easily be identified. Experiments with isolated sarcoplasm proteins indicate that the radiation-induced fraction is a result of aggregation. Storage experiments with irradiated meat have shown the radiation-induced fraction to be stable; its amount increases with increasing radiation dose. By using chromogenic and fluorogenic enzyme tests for esterases, lipases and peroxidases we have found a new enzymatically active zone which probably consists of enzymatically active aggregates. Thin-layer-isoelectric focusing of the sarcoplasm proteins provides another criterion for recognition of irradiated meat. A decrease in the amount of basic proteins and of some proteins in the neutral pH-range has been observed in meat irradiated with 1 or 5 Mrad. Separation patterns of sarcoplasm proteins of irradiated meat differ qualitatively (particularly when a dose of 5 Mrad has been used) from those of unirradiated meat by considerable background-staining between the zones. (auth)

25280 (EUR-5126d/e/f/i/n, pp 45-60) USE OF ELECTROPHORETIC TECHNIQUES FOR THE IDENTIFICATION OF SOME IRRADIATED FOODS. Vander Stichelen Rogier, M. (Institut d'Hygiene et d'Epidemiologie, Brussels). 1974. (In French).

In international colloquium, the identification of irradiated foodstuffs.

Three electrophoresis techniques have been tested for separating proteins extracted by means of a buffer solution from irradiated and non irradiated (control) samples of food. The techniques were vertical electrophoresis in starch gel, electrophoresis in polyscrilamide gel and isoelectric focusing in polyacrylamide gel. The following foodstuffs were studied: beef (0.5 and 5 Mrad), cod fillet (1 Mrad), whole liquid egg (0.5 and 1 Mrad), shrimp (200 krad), cultivated mushroom (200 krad), white potato (15 krad) and onion (10 krad). For certain foodstuffs differences were observed in the separation of the extracts from irradiated samples and non-irradiated samples, particularly in the reduction or disappearance of certain groups of proteins. These results and the possibility of their practical use are discussed. (auth)

25281 (EUR-5126d/e/f/i/n, pp 109-116) QUALITATIVE COMPARISON AND THEORETICAL DISCUSSION OF HYDROCARBONS AND OXYGEN COMPOUNDS AS FISSION PRODUCTS AFTER IRRADIATION OR HEATING OF FATS, OILS, AND MODEL MATERIALS. Drawert, F. (Technische Universitaet, Munich). 1974. (In German).

In international colloquium, the identification of irradiated foodstuffs.

Hydrocarbons and oxygen compounds formed from tripalmitate, tristearate, trioleate, oleic acid methyl ester, linoleic acid methyl ester, lauric acid, lard, coconut butter, sunflower oil and olive oil, by irradiation at 0.5 to 6 Mrad or by heating up to 170°C for 24 hours, are compared, the main points of formation deduced and the substances discussed from the mechanistic angle on the basis of the available literature. Comparisons between radical reactions and enzymic reactions are also made. (auth)

25282 (EUR-5126d/e/f/i/n, pp 193-202) DETECTION OF PREVIOUS IRRADIATION OF POTATOES BY MEASUREMENT OF ELECTRICAL CONDUCTIVITY. Scherz, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe). 1974. (In German).

In international colloquium, the identification of irradiated foodstuffs.

Irradiation causes a decrease of the electrical conductivity of potatoes which is dependent on the potato variety. It was further observed that with unirradiated potatoes, the conductivity decreases immediately after sticking the electrodes into the tubers until constant values of conductivity are reached after three minutes. This initial decline of conductivity is less pronounced in irradiated tubers and disappears completely in potatoes irradiated with doses above 50 krad. This effect of irradiation is nearly independent of variety and storage conditions. It permits distinction between irradiated and unirradiated potatoes as long as the latter remain unsprouted. (auth)

25283 (EUR-5126d/e/f/i/n, pp 203-215) ADDITIONAL MEASUREMENTS OF CONDUCTIVITY CHANGES IN POTATOES INDUCED BY IONIZING RADIATION. van Dongen, R.; Onderdelinden, D.; Strackee, L. (National Inst. of Public Health, Bilthoven, The Netherlands). 1974.

In international colloquium, the identification of irradiated foodstuffs.

In order to corroborate the work performed at Karlsruhe on the conductivity changes in potatoes irradiated with fast electrons, additional measurements are made in potatoes irradiated with γ-rays at a relatively low dose rate. Using different types of electrodes and an automated conductivity measuring equipment the general aspects of the work mentioned above were confirmed. Whereas in unirradiated potatoes the initial conductivity after the insertion of the electrodes changes rapidly, this effect is markedly less in irradiated potatoes. The effect saturates at doses over approximately 40 krad and is relatively stable over periods of several months after irradiation. In order to study the behavior of the impedance in more detail, the real and imaginary parts were measured in a frequency range from 50 Hz to 50 kHz both for irradiated and unirradiated potatoes. A special type of equipment was developed for this purpose. From a study with potatoes irradiated with fast electrons it was found that the decrease of the conductivity changes here described, develop only in several hours after the irradiation. This indicates that the underlying mechanisms are closely linked to biological processes in the tissue cells. (auth)

25284 (EUR-5126d/e/f/i/n, pp 269-277) RADIATION-INDUCED ALTERATIONS IN SOME NATURAL PIGMENTS OF SOME FOOD PRODUCTS. Snauwaert, F. (Katholieke Universiteit, Louvain, Belgium). 1974.

In international colloquium, the identification of irradiated foodstuffs.

Carotenoids, chlorophylls, and myoglobin are three widespread pigment groups of food. This communication summarizes the influence of gamma-irradiation on those pigments. In a first chapter the influence of radurization on the carotenoids in Belgian shrimp and salmon species is discussed. The stability of those pigments in vivo is compared to the stability of β-carotene and canthaxanthin in model systems. In a second chapter the degradation products formed upon gamma irradiation of chlorophylls in peas are reported. Finally the changes in color of irradiated meat (beef, horse, pork) will be mentioned. (auth)

25285 (EUR-5126d/e/f/i/n, pp 297-302) IDENTIFICATION OF IRRADIATED FOOD: GENERAL REVIEW AND CONCLUDING REMARKS. Diehl, J. F. 1974.

In international colloquium, the identification of irradiated foodstuffs.

A tabulated review of the purposes and doses used for food irradiation, the food irradiated, the radiation effects, and the techniques for identification of the radiation effects is presented and its significance is briefly discussed in light of the papers presented at the conference. (JSR)

25286 (EUR-5126d/e/f/i/n, pp 305-324) IDENTIFICATION OF IRRADIATED FOODSTUFFS: RESULTS OF A EUROPEAN RESEARCH PROGRAMME. Deschreider, A. R. (Ministry of Economics Affairs, Brussels). 1974.

In international colloquium, the identification of irradiated foodstuffs.

This report contains a description and a synthesis of the individual results of an European research program concerning physical, chemical, and biological changes in irradiated foodstuffs. This program has been performed by a number of laboratories within the European Community in collaboration with the Health Protection Directorate of the European Commission. The aim of the program was to determine methods for the identification of irradiated foodstuffs, in order to establish adequate practical techniques to control the legal measures taken in the Member States. This research program started in April 1967 and the results obtained cover very interesting findings and positive responses, making possible the development of such identification methods for a certain number of products. Furthermore, much data obtained provides additional evidence for evaluating the wholesomeness of irradiated food. (auth)

25287 (EUR-5126d/e/f/i/n, pp 337-351) DIFFERENT PATTERNS OF WEIGHT LOSS OF IRRADIATED VEGETABLES. Magaudda, G. (CNEN, Rome). 1974. (In Italian).

In international colloquium, the identification of irradiated foodstuffs.

As a sequence to previous studies showing a direct relation between weight loss of irradiated fruit and the absorbed gamma radiation dose, studies were made to determine if a similar relation existed for strawberries and potatoes. By means of a device developed for the purpose it is possible to decrease the analysis time from several days to a few hours. The preliminary results of experiments made to make some darkening differences observed inside the potato quantitatively measurable are reported. (tr-auth)

25288 ION FORMATION IN LOW-TEMPERATURE RADIOLYSIS OF ISOPROPYL CHLORIDE. Cukhov, F. F.; Slovokhotova, N. A.; Borshagovskaya, L. S.; Karatun, A. A.; Pankratov, A. N. (Physical-Chemistry Inst., Moscow). Dokl. Akad. Nauk SSSR; 219: No. 3, 667-670(21 Nov 1974). (In Russian).

Results obtained in the previous low-temperature radiolysis of alkyl chlorides were explained on the assumption of the formation of the non-paramagnetic ion $(CH_3)CH^+$ formed as a result of the heterolytic break along the C−Cl bond. This assumption was confirmed by studies of the ir spectrum obtained by the action of HCl on isopropyl chloride. Comparative studies were then made of the ir spectra obtained from the low-temperature irradiation of glass and crystalline isopropyl chloride. The spectra obtained indicated quite different patterns of radiolysis. These differences were explained on the assumption of ionized regions of different structure and dimensions in the crystalline and amorphous samples. (JSR)

25289 FREE RADICALS IN AN ADAMANTANE MATRIX. X. Electron Paramagnetic Resonance and INDO Study of Fluorinated Cyclohexadienyl Radicals. Yim, M. B.; Wood, D. E. (Univ. of Connecticut, Storrs). J. Amer. Chem. Soc.; 97: No. 5, 1004-1010(5 Mar 1975).

Cyclohexadienyl radical and six fluorinated cyclohexadienyl radicals were prepared by x irradiation of adamantane matrices doped with: benzene, monofluoro-, 1,4-difluoro-, 1,3,5-trifluoro-, 1,2,4,5-tetrafluoro-, pentafluoro-, and hexafluorobenzene. The epr spectra obtained were analyzed by computer simulation. The substitutions of fluorine in the ring did not greatly affect the remaining hydrogen hfs constants in the ring but there was a substantial effect on the methylene hydrogen hfs constants which was explained in terms of the effect of fluorine on hyperconjugation. Fluorine was found to be ortho-para directing for hydrogen atom addition, and hydrogen atom addition at the site of a fluorine was observed only for hexafluorobenzene. A very large H/D isotope ratio was observed when adamantane-d_{16} (97.7% D) was used as a matrix. INDO energy minimization to obtain the optimum geometry for cyclohexadienyl radical resulted in a distorted planar hexagon and gave the experimentally observed ordering of the hfs constants. The major experimental hfs trends upon fluorine substitution were also correctly predicted by INDO. (auth)

25290 CHEMICAL EFFECTS OF FISSION RECOILS. II. Influence of Density and Oxygen Concentration on Product Formation in Ethylene. Meisels, G. G.; Gregory, J. P.; Siddiqi, A. A.; Freeman, J. P.; Richardson, W. C. (Univ. of Houston, TX). J. Amer. Chem. Soc.; 97: No. 5, 987-993(5 Mar 1975).

The radiolysis of gaseous ethylene induced by recoils from fissioning ^{235}U has been investigated in the density range 9×10^{-3} to 1.1×10^{-1} g cm^{-3} in the presence of small amounts of oxygen. The effect of density on acetylene yields was in accord with stabilization of initially formed excited molecules and/or ions, and with a change from differential to total energy loss of the fission recoil. From such studies the fission recoil range in ethylene was estimated to be 0.05 g cm^{-2}. The addition of oxygen was found to suppress the yields of n-butane and hexene-1 albeit only partially, but caused an increase in some other product yields. Plausible mechanisms consistent with reaction rate data are suggested and compared with conventional low-pressure ethylene radiolysis results. (auth)

25291 STUDIES ON CHANCES OF MODIFYING POLYAMIDE CORD THREAD BY MEANS OF ORGANIC COMPOUNDS CONTAINING CHLORINE, OF ISOPROPYLBENZENE HYDROPEROXIDE AND OF IONIZING RADIATION. Kuzmanow, B.; Tenczew, C.; Nikolinski, P.; Chodkiewicz, L. Przem. Chem.; 54: No. 1, 23-26(1975). (In Polish).

An attempt has been undertaken at verifying the chance of modifying polyamide cord thread Widlon 840/2De by means of chloroethane, tetrachloroethylene and solutions of dichloroamine T in dichloroethane and in tetrachloroethylene. Studies were carried on concerning some properties of polyamide cord thread after its modification by means of isopropylbenzene hydroperoxide. It has been established that the modification decreases in a slight, but measurable degree, the relative lengthening of polyamide cord thread, its stress being increased simultaneously. When polyamide cord thread is irradiated with γ rays in presence of air the properties are changed slightly within limits of 2×10^4 to 3×10^5 R. (auth)

25292 PRIMARY RADIATION PRODUCTS IN X-IRRADIATED DIHYDROMETHYLURACIL. Budzinski, E.E.; Box, H.C. (Biophysics Department, Roswell Park Memorial Institute, Buffalo, New York 14203). J. Chem. Phys. 62: No. 5, 2006-2007 (1 Mar 1975).

ESR and ENDOR measurements have been made on single crystals of 5,6-dihydro-6-methyluracil and its ND analog, x-irradiated at 4.2°K. The radiation products are identified by analysis of the hyperfine splitting. (AIP)

25293 THE ESR SPECTRUM OF PH_4. Colussi, A.J.; Morton, J.R.; Preston, K.F. (Division of Chemistry, National Research Council of Canada, Ottawa, Canada). J. Chem. Phys. 62: No. 5, 2004-2006 (1 Mar 1975).

The ESR spectrum of PH_4 and PD_4 radicals produced in a neopentane matrix by γ radiation is reported. The results indicate that structure of the radical is bipyramidal, rather than tetrahedral or square-planar. (AIP)

25294 AN INVESTIGATION OF ELECTRON THERMALIZATION IN IRRADIATED GASES USING CCl_4 AS AN ELECTRON ENERGY PROBE. Warman, J.M. (Interuniversity Reactor Institute, Mekelweg 15, Delft, The Netherlands); Sauer, M.C. Jr. J. Chem. Phys. 62: No. 5, 1971-1981 (1 Mar 1975).

The attachment of electrons to CCl_4 has been studied in pulse irradiated argon and its admixtures with several atomic and molecular compounds under conditions where the timescale of attachment is comparable with that of electron thermalization. Using the known energy dependence of the rate constant for attachment, the resulting complex electron decay kinetics have been quantitatively related to the energy relaxation process. Values of the energy exchange rate coefficient K_u defined by the relationship $d\bar{u}/dt = -K_u \cdot [\bar{u} - (3/2)\,kT] \cdot N_M$ have been determined for 18 compounds of varying complexity and dipole moment. The values of K_u found encompass the range from 1.3×10^{-13} cm^3 sec^{-1}, for argon, to 1.5×10^{-8} cm^3 sec^{-1}, for acetone. The results are compared with energy exchange parameters available from other sources. Thermalization times and ranges of electrons in irradiated gaseous and liquid systems are calculated and their relevance to radiation chemistry is discussed. (auth)

25295 A METHOD FOR MANUFACTURING INTERNALLY-COATED POROUS MACRO-MOLECULAR MATERIALS, AND MATERIALS THUS OBTAINED. Marchand, J.; Puig, J. R. (to CEA, 75-Paris (France)). French Patent 2181215/D/. 21 Apr 1972. 13p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The method comprises submitting a polymer to irradiation by heavy nuclear particles, chemically fixing a monomer having at

least one double ethylenic link in the areas altered by the irradiation and localized about the path of each particle, and generating porosity by means of a chemical etchant selected according to said polymer. The materials thus obtained can be used, for example, as ion-exchanger membranes or as selective semi-pervious membranes. (FR)

25296 A METHOD FOR DISCOLORING AQUEOUS RESIDUAL EFFLUENTS CONTAINING A DISSOLVED OR DISPERSED ORGANIC SUBSTANCE. Case, F. N.; Ketchen, E. E. (to USAEC, Washington, D. C.). French Patent 2179129/A/. 4 Apr 1973. 9p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France). Priority claim: 4 Apr 1972, USA.

A procedure is described for the treatment of liquid or gaseous effluents containing dissolved or dispersed organic material with regeneration of the sorbant used. The procedure is characterized by contacting the effluent, such as a gaseous effluent, with a carbonaceous sorbant in inert particles under an oxygen pressure up to 140 kg/cm^2. The mixture is irradiated at high energy up to the point of decoloration and then the decolored liquid is separated. Such a procedure is particularly convenient in the decoloration of water containing an organic dye coming from the fabrication of paper or textile processing. (tr-FR)

25297 YIELDS OF POSITIVE IONS IN THE RADIOLYSES OF LIQUID HYDROCARBONS. Propane and Cyclohexane. Wade, T.; Shida, S.; Hatano, Y. (Tokyo Inst. of Tech.). J. Phys. Chem.; 79: No. 6, 561-565(13 Mar 1975).

The yields of positive ions produced in the radiolyses of liquid propane and cyclohexane have been estimated by using a proton acceptor (NH_3) together with an electron scavenger (SF_6) and a radical scavenger (O_2). In liquid propane the G value of fragment ion $C_2H_5^+$ is estimated to be 0.3, which is in good agreement with that obtained by Koob and Kevan making use of predeuterated propane. The G value of parent-minus-H ion $C_3H_7^+$, which is found to be 0.7, is larger than that for $C_2H_5^+$. In liquid cyclohexane, the formation of parent-minus-H ion c-$C_6H_{11}^+$ is observed with a yield of 0.7. Further, an attempt to estimate the yields of parent ions produced in the radiolyses of liquid propane and cyclohexane has been made on the basis of the presumed ionic processes. These results, especially the relatively large yields of parent-minus-H ions, indicate a characteristic mode of the fragmentation of excited parent ions in liquid hydrocarbons as compared with that in the gas phase. (auth)

25298 RADIATION-INDUCED GRAFT COPOLYMERIZATION N-2,4-DIMETHYLPHENYL-MALEIMIDE ONTO THE SILICON RUBBER. Migunova, I. I.; Sergutin, V. M.; Ivanov, V. S. Vestn. Leningrad. Univ., Fiz., Khim.; 22: No. 4, 151-152(Nov 1974). (In Russian).

The graft copolymer of N-2,4-dimethylphenylmaleimide onto polydimethylsiloxane SKTV-2 was obtained by γ-ray action. Optimum conditions of grafting up to 20% imides have been determined. (auth)

25299 INFLUENCE OF ZONE-MELTING PURIFICATION OF N-PHENYL-AND N-BENZYL-MALEIMIDES ON THEIR RADIATION-INDUCED SOLID-STATE POLYMERIZATION. Orlova, L. F.; Vasil'eva, I. V.; Ivanov, V. S. Vestn. Leningrad. Univ., Fiz., Khim.; 22: No. 4, 135-140(Nov 1974). (In Russian).

N-Phenyl- and N-benzyl-maleimides subjected to zone-refining demonstrated complicating dependence of solid-state polymerization rate. The increasing of the purification degree of monomers tends to increase thermostability and heat distortion temperature of the polymers. The intrinsic viscosity of polymers is unchanged compared with the zone-refining degree of monomers. (auth)

25300 SELECTIVE HYDROGEN ATOM ABSTRACTION BY HYDROGEN ATOMS IN PHOTOLYSIS AND RADIOLYSIS OF NEOPENTANE–ALKANE MIXTURES AT 77°K. Miyazaki, T.; Hirayama, T. (Nagoya Univ., Japan). J. Phys. Chem.; 79: No. 6, 566-570(13 Mar 1975).

Selective hydrogen atom abstraction in the photolysis and radiolysis of neopentane containing a small amount of alkane has been studied by esr spectroscopy and product analysis with mass spectrometer. When neo-C_5H_{12}-i-C_4H_9D–HI is illuminated with ultraviolet light at 77°K, t-C_4H_9 radical, H_2, and HD are formed. A remarkable isotope effect is observed in the abstraction reaction. H atoms migrate a long distance through the matrix without reacting with neopentane molecules. The selective hydrogen atom abstraction reaction occurs efficiently in the solid at 77°K, while it does not occur at all in the solid at 198 K and in the liquid at 262 K. When pure neopentane is γ irradiated at 77°K, neo-C_5H_{11}, t-C_4H_9, and unidentified radicals are produced. A remarkable preirradiation effect is observed on the formation of t-C_4H_9 and the unidentified radical. t-C_4H_9 and the unidentified radicals are not formed directly by the decomposition of neopentane, but by the reaction of H atoms, which are produced by the radiolysis of neopentane, with impurities or products. When neopentane containing a small amount of alkanes is γ irradiated at 77°K, the solute alkyl radicals are formed predominantly. H_2 and HD are formed in the radiolysis of neo-C_5H_{12}-i-C_4H_9D at 77 K, while D_2 is not formed at all. The solute radicals are formed by the selective hydrogen atom abstraction from the solute alkane by H atoms produced by the fragmentation of neopentane. (auth)

25301 IRRADIATING POLYETHYLENE COMPOSITION CONTAINING MONOMER OR POLYMER ADDITIVE. Rainer, W. C.; Redding, E. M.; Hitov, J. J.; Sloan, A. W.; Stewart, W. D. (to W. R. Grace and Co.). Canadian Patent 959,450. 17 Dec 1974. vp.

It is a primary object of the invention to prepare condensation products of polyethylene with other non-polar or slightly polar polymers and ethylenically unsaturated monomers having increased toughness and rigidity. Another object of the invention is to reduce discoloring in graft polymerization. (auth)

25302 MASS SPECTROSCOPIC STUDY OF CHLORINE SEPARATION IN THE RADIOLYSIS OF NaCl CRYSTALS. Tsal, N. A.; Karavan, Yu. V.; Didyk, R. I.; Dragan, O. P. (Lvov State Univ.). Dokl. Akad. Nauk SSSR; 219: No. 2, 333-335(11 Nov 1974). (In Russian).

The results of the mass spectrographic, optical, and mechanical measurements of chlorine release from NaCl crystals containing oxygen impurities in the form of the doubly charged ion O^{2-} after x irradiation at temperatures from 265 to 400° were reported. Non-irradiated crystals and crystals irradiated below 280° showed no signs of chlorine release. At an irradiation temperature of 285 to 290° Cl^+ currents are observed. With increase of temperature the chlorine is observed earlier in the irradiation period. The absorption spectrum shows narrow X bands at lower temperatures. With increase of temperature the bands broaden and are displaced to longer wavelengths. Irradiation of powdered samples showed a substantial increase in the intensity of the individual bands and a decrease of the emission period of the gas. A mechanism to explain these results was proposed. (JSR)

25303 COBALT-60 γ-RADIATION PROCESSING OF BAMBOO–POLYMER COMPOSITES. Adur, A. M.; Nigam, S. K. (Bhabha Atomic Research Centre, Bombay). Isotopenpraxis; 11: No. 1, 21-24(Jan 1975).

The paper describes some of the works carried out on the preparation and properties of ^{60}Co γ-radiation-processed bamboo-polymer composites. Some of the applications are also discussed with special reference to using these composites for tensile reinforcement of concrete. (auth)

25304 STUDIES IN RADIATION CHEMISTRY. Shaede, E. A. Vancouver, B. C.; British Columbia Univ. (1971). 193p.

Thesis.

A study of the reaction of hydrated electrons with molecular nitrogen is reported along with results of an investigation of the effects of γ-radiation on the polar aprotic solvent, propylene carbonate: (a) in the glassy solid state at 77°K and (b) as a liquid at room temperature. Hydrated electrons were generated by γ-radiolysis of aqueous solutions containing H_2 and OH^- and also containing N_2 at concentrations up to 0.1 M (200 atm pressure). Although the hydrated electron is one of the most powerful reducing agents, it was unable to cause reduction fixation of molecular nitrogen. An upper limit of $K_1 < 18\ M^{-1}s^{-1}$ was estimated for the rate constant of the reduction reaction. In the glassy solid state at 77°K, γ-irradiation of propylene carbonate yielded species identified as trapped electrons. The electrons were unstable at 77°K and decayed by a non-homogeneous process believed to be reaction with positive ions. Ultraviolet photolysis of the irradiated glasses at 77°K produced radicals identified as CO_3^-, HCO and CH_3. Gamma radiolysis of liquid propylene carbonate at 25°C produced H_2, CO and CO_2 as the major gaseous molecular products. Methane was also produced via a secondary process involving methyl radicals. (CA)

25305 PRODUCTS OF γ-IRRADIATION OF $Fe(CN)_5NOSO_4^{4-}$:. An Electron Spin Resonance Study. Symons, M. C. R.; West, D. X.; Wilkinson, J. G. (Univ. of Leicester, Eng.). Inorg. Nucl. Chem. Lett.; 11: No. 1, 55-60(Jan 1975).

When aqueous solutions containing the pentacyanonitroferrate(II) ion, $Fe(CN)_5NO_2^{4-}$, are reduced, a species having ESR parameters of $A_1 = 10 \pm 2$ G, $A_2 = 32 \pm 2$ G, $A_3 = 15 \pm 2$ G and $g_1 = 1.9282$, $g_2 = 1.9993$, $g_3 = 2.008$ is formed. The chemical nature of this species has been the source of controversy. A species having similar ESR parameters can also be formed by γ-irradiation of anhydrous $Na_2Fe(CN)_5NO$ and $Na_4Fe(CN)_5NO_2$ as well as numerous glasses of each of these. In an effort to define more clearly the

nature of species capable of yielding such spectra, a report is presented on ESR results on the products of γ-irradiation of the $Fe(CN)_5NOSO_4^{-}$ ion. (auth)

25306 RANDOM CHAIN SCISSION OF POLYSTYRENE IN ELECTRON IRRADIATED SOLUTION. Herrick, C. S. (General Electric Co., Schenectady, NY). J. Polym. Sci., Polym. Phys. Ed.; 12: No. 9, 1849-1856(Sep 1974).

Main-chain scission was the predominant effect when dilute solutions of three linear polystyrenes in 1-methylnaphthalene and polybenzyl oligomer received up to 2000 megaroentgen of 1.5-MeV electrons. Values of energy per scission were independent of dose and of the same magnitude as literature values in dioxane and benzene solutions when compared at the same dose rate. In all cases as irradiation progressed, M_w/M_n approached a value of 2 and M_z/M_w approached a value of 1.5 characteristic of a random distribution. Starting from one initial distribution, random numbers were used to simulate random chain scission. A 500 MR (megaroentgen) distribution calculated in this manner matched the experimental distribution after a 500 MR irradiation. (auth)

25307 OPTICAL ABSORPTION SPECTRA OF γ-IRRADIATED 3,4-POLYISOPRENE AND 1,2-POLYBUTADIENE. Zott, H.; Heusinger, H. (Technische Univ., Munich). J. Phys. Chem.; 79: No. 7, 711-713(27 Mar 1975).

The optical absorption spectra of γ-irradiated 3,4-polyisoprene and 1,2-polybutadiene were investigated. Allyl radicals, dienes, and diene ions could be observed. (auth)

25308 LOW-TEMPERATURE PULSE RADIOLYSIS. III. Ionic Species Produced from Aliphatic Ketones. Arai, S.; Hoshino, M.; Imamura, M. (Inst. of Physical and Chemical Research, Saitama, Japan). J. Phys. Chem.; 79: No. 7, 702-707(27 Mar 1975).

Absorption spectra of transient species produced at low temperatures by pulse radiolysis of pure acetone have been measured. Similar measurements have been carried out for 11 aliphatic ketones including acetone in tetrahydrofuran and/or 2-methyltetrahydrofuran solutions. The absorption bands at 500 and 750 nm in pure acetone are assigned to monomer anions and cations of acetone, respectively, on the basis of the effects of various scavengers and on comparisons with spectra observed for pulse irradiated tetrahydrofuran solutions of acetone at 178°K and γ-irradiated glassy n-butyl chloride solutions of acetone at 77°K. The molar extinction coefficient of an acetone anion at 500 nm has been determined to be 5×10^3 M^{-1} cm^{-1}. The pulse irradiation of ethereal solutions of aliphatic ketones produces intense transient absorption bands in the visible and near-infrared regions. The peak is located at 500 nm for acetone, 510 nm for methyl ethyl ketone, 600 nm for methyl isopropyl ketone, 560 nm for methyl isobutyl ketone, 550 nm for diethyl ketone, 520 nm for diisopropyl ketone, 775 nm for cyclopentanone, 580 nm for cyclohexanone, 680 nm for cycloheptanone, 775 nm for cyclooctanone, and 640 nm for cyclododecanone. All the absorption bands are ascribed to molecular anions of these ketones. (auth)

25309 FORMATION OF ION PAIRS IN IRRADIATED CHARGE-TRANSFER SYSTEMS. Irie, M.; Irie, S.; Yamamoto, Y.; Hayashi, K. (Osaka Univ.). J. Phys. Chem.; 79: No. 7, 699-701(27 Mar 1975).

Radiation effects on the electron donor–acceptor (EDA) complex, especially the ion-pair formation process in the glassy state at 77°K, were studied. The yield of the radical anion of pyromellitic dianhydride (PMDA) in n-butyl chloride-2-methyltetrahydrofuran matrix containing PMDA is increased by the addition of ethylbenzene, which is known to form a stable EDA complex with PMDA. The adsorption spectrum of the radical anion thus formed has a peak at 668 nm and a rather broad band width. The peak position and the band width are different from that of the free-radical anion and similar to the anion formed by photoillumination of the complex which indicates that the radical anion exists as an ion pair and has considerable interaction with the countercation. The effects of sensitizers and quenchers prove that the excited EDA complex formed by radiation dissociates into separated ion pairs in their highly excited singlet states. (auth)

25310 RADIATION CROSSLINKING OF ELASTOMERS. I. Polybutadienes. Pearson, D. S.; Shutnik, B. J.; Boehm, G. A. (Firestone Tire and Rubber Co., Inc., Akron, OH). J. Polym. Sci., Polym. Phys. Ed.; 12: No. 5, 925-939(May 1974).

The chemical and physical crosslink densities of irradiated polybutadiene were determined using a precise and consistent method. This method included the use of a statistical theory of crosslinking modified to include chain reactions and the use of Langley's theory for calculating the number of trapped chain entanglements. The number of crosslinks formed per unit radiation dose, G(X), was measured for a series of polybutadienes containing various isomeric forms of unsaturation. The physical crosslink density and the molecular weight between entanglements were determined from measurements of the compression modulus of swollen samples. (auth)

25311 POLYTHIOL ACCELERATED RADIATION CROSS-LINKING OF OLEFINICALLY UNSATURATED POLYMERS. Zapp, R. L.; Oswald, A. A. (to Exxon Research and Engineering Co.). US Patent 3,864,229. 4 Feb 1975. Filed Date 6 Mar 1972. 24p.

Improved radiation vulcanization of elastomers is accomplished by incorporating into the elastomer composition a polythiol. The polythiol is preferably a hydrocarbon thioether thiol and is normally liquid at room temperature with a molecular weight of at least 150. Though difunctional polythiols are operative in this invention, the preferred polythiols have about three to about five thiol groups per molecule. (Official Gazette)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 25274.

25312 (CNEA-371) PREPARATION OF ^{131}I-METHYLENE BLUE. de Salas, G. N. B.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 8p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

The labelling of methylene blue (3,7 dimethylamino phenazotionio chloride) with radioiodine with a radiochemical yield of 63% is described. Different methods of purification for the labelled product were assayed, and the radiochemical purity obtained was 99%. The stability conditions for the compound were also studied. (auth)

25313 (CNEA-372) PREPARATION OF ^{131}I RED. de Suarez, A. H. F.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 10p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

A method for labelling Congo Red with ^{131}I using Chloramine T as oxidizing agent is described. The radiochemical yield was 70%. The product was purified with AgCl. The toxicity and stability of the labelled compound were checked. The product was tested in rats for its use in the diagnosis of amiloidosis. (auth)

25314 (CNEA-378) PURIFICATION AND STABILITY OF INSULIN ^{125}I. Quihillalt, L. E.; Arciprete, J. A.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 13p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

A quick and easy method to label and purify ^{125}I-insulin is described. Different quantities of oxidant agent were assayed in the labelling method. The stability of the labelled product was tested after liophylization. (auth)

25315 NON-VOLATILE FLUORINATED ALIPHATIC BROMINE-82 TRACERS FOR USE IN ORGANIC MEDIA. Amdur, S. (Israel Atomic Energy Commission, Yavne). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 575(Dec 1974).

The production of a fluorinated aliphatic bromine polymer solution is described, 1 gm of which when irradiated for 5 min at 5×10^{12} neutron/cm^2 sec yielded 150 μCi ^{82}Br. No evidence for the decomposition of the bromine compound was analytically observed. The potential use of the material, where organic compounds tagged with ^{82}Br are needed for industrial tracer work with non-aqueous media, such as petroleum and its derivatives, is stressed. (UK)

Hot-Atom Chemistry

Refer also to abstract 25290.

25316 REACTIONS OF RECOIL CHLORINE. P. 4. A Simple Model for the Analysis of Results from Mixtures. The Evaluation of Reaction Cross-Sections. Kontis, S. S.; Urch, D. S. (Democritus Nuclear Research Center, Athens (Greece). Dept. of Chemistry). Radiochim. Acta; 20: No. 1/2, 39-46(1973).

11 figs.; 4 tabs.; 7 refs.

A simple theory was developed for analysis of results from a study of the reactions of recoil chlorine atoms. In aliphatic systems the variations of organic yield can be linearly related to sample composition if specific reaction cross-section parameters are ascribed to each component. These parameters are a function of molecular size, molecular reactivity, and the reactivity, number and type of the radicals derived from the molecule. The simple theory could not be applied to results from systems containing

chlorobenzene. A modification was therefore introduced to take into account the second stage reaction with chlorobenzene. It was concluded that in aliphatic systems the organic yield is made in a single "hot" zone, but with chlorobenzene there exist reactions of thermal atoms, which produce chlorine-labeled organic compounds. (auth)

25317 SZILARD–CHALMERS REACTIONS IN THE HEXAHALOCOMPLEXES OF IRIDIUM. Separation and Identification of the Recoil Products. van Ooij, W. J.; Houtman, J. P. W. (Interuniversitair Reactor Instituut, Delft (Netherlands)). Radiochim. Acta; 20: No. 1/2, 21-26(1973).

The ^{192}Ir-labelled products present in aqueous solutions of neutron-irradiated hexahalocomplexes of tri- and tetravalent iridium were separated by high-voltage electrophoresis, thin-layer electrophoresis, thin-layer chromatography, and by two-dimensional techniques. The intricate mixtures of recoil products were completely resolved and the presence of approximately 35 products could be demonstrated. These products comprise all members of the series $^{192}IrCl_{(6-x)}(H_2O)_x^{(x-3)}$ $(0 < x < 6)$ and the dimeric aquohalocomplexes $^{192}IrCl_{(10-x)}(H_2O)_x^{(x-4)}$ $(0 < x < 5)$. The remaining products are the stereoisomers of these monomers and dimers. In solutions of anhydrous complexes of tetravalent iridium a third major product is found, which shows a behaviour unlike that of the aquohalocomplexes. Its properties are consistent with a polymeric structure, $H_5[^{192}Ir(V)(Ir(IV)Cl_6)_5]$. (auth)

25318 THE SPIN STATES OF IODOCARBENE PRODUCED FROM THE REACTIONS OF FISSION IODINE WITH METHANE. Kikuchi, M.; Church, L. B. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Radiochim. Acta; 20: No. 1/2, 81-84(1973).

One of the chemical reactions of fission-produced iodine, (*I), with gaseous methane is to form an excited state of methyl iodide, [CH_3*I]. This species can undergo unimolecular decomposition to form iodocarbene, CH*I, which can be chemically scavenged with ethylene. It is postulated that the iodocarbene is formed in the triplet and singlet spin states, and that these chemically react in a manner similar to methylene and the other halocarbenes. In order to determine the relative energies of the two spin states, the reactions of CH*I were studied as a function of pressure both with and without oxygen. It is concluded that ^{3}CH*I, made primarily by independently produced fission iodine, is the more excited species. Conversely, the ^{1}CH*I, made via the iodine that has undergone β^--decay, is the lower energy or ground state species. (auth)

25319 USE OF A PULSED REACTOR AS A TOOL FOR THE STUDY OF THE CHEMICAL BEHAVIOR OF BROMINE AND IODINE AFTER (n,γ) REACTION IN ORGANIC MEDIUM. Llabador, Y.; Halter, M. E. (Reactor del Centro Nuclear, Mexico City). Radiochem. Radioanal. Lett.; 20: No. 4-5, 241-249(28 Feb 1975).

In order to study the chemical behavior of halogen atoms after (n,γ) reaction, comparative pulsed and standard neutron irradiations of Br_2 and I_2 in organic solvents were carried out in both the liquid and gas phase. The results show that a 2500-fold increase of the thermal neutron flux density does not influence the organic yields. It is concluded that in the liquid phase the stabilization time of the recoil halogen atoms is shorter than 10^{-7} sec and of the order of mean-life of free radicals. (auth)

Properties of Radioactive Materials

Refer also to abstracts 25246, 25248, 25256, 25270, 25761, 25762, and 26229.

25320 (AD-783427) FINAL REPORT No. 1, 31 MARCH 1971–APRIL 1974. Zero-field paramagnetic investigations. Bernstein, E. R. (Princeton Univ., N. J. (USA). Dept. of Chemistry). 5 Aug 1974. Contract DAHC04-71-C-0027. 26p. (AROD-9679.4-C). NTIS $3.25.

Summaries are presented of research on borazine, symtrioxane, sym-triazine, rare earth borohydrides, uranium borohydride, zero-field paramagnetic resonance and zero-field relaxation studies. Details of previously unavailable rare earth borohydride and symtrioxane work are presented in some detail, including synthesis and spectra. (GRA)

25321 (ARH-ST-106) P-11 FACILITY CLEANUP SUMMARY REPORT. Raile, M. N. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Dec 1974. Contract AT(45-1)-2130. 47p. Dep. NTIS $4.25.

This document describes methods, techniques, and equipment employed at Hanford for the cleanup, dismantling, and decommissioning of plutonium-contaminated facilities. (auth)

25322 (CNEA-373) RAPID METHOD FOR LABELLING LIPIDS WITH ^{131}I. Correia, R. J.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 7p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

A simple and rapid method for labelling lipids with ^{131}I is described. It can be applied in preparations with short half-life radioiodine. The labelling technique consists of a dissolution of the lipid and then its reaction with a solution of Cl I (P. A.) both in dry ethyl ether. This solution was first labelled by exchange with a small volume of high concentration activity Na ^{131}I in water. The lipid labelling is instantaneous and 100% the radiochemical yield. The radiochemical purity is controlled by ascendent paper chromatography and then the separated sectors are evaluated in a scintillation counter. (auth)

25323 (CNEA-374) PREPARATION OF THE ^{99m}Tc-TIN-PYROPHOSPHATE IN THE NATIONAL COMMISSION OF ATOMIC ENERGY, ARGENTINA. Noto, M. G.; de Castiglia, S. G.; Palcos, M. C.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 14p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

Preparation of ^{99m}Tc-tin-pyrophosphate for bone scanning is described. It includes the control methods used and the distribution studies in experimental animals. Stability assays of the solution before and after labelling were performed. (auth)

25324 (SAN-849-3) SYNTHESIS AND EVALUATION OF ^{11}C-LABELED ORGANIC COMPOUNDS FOR USE IN NUCLEAR MEDICINE. Lin, T. H.; Winchell, H. S. (Medi-Physics, Inc., Emeryville, Calif. (USA)). Jan 1975. Contract AT(04-3)-849. 14p. Dep. NTIS $4.00.

Research accomplishments are summarized. Flushing of the cyclotron target for recoil production of H^{11}CN was improved by developing heating elements for the target that would insure uniform high temperatures on all surfaces of the target during bombardment and washout of the radioactive gas. An evaluation of the H^{11}CN flushed in the gas phase from the target was completed. Groups of ^{11}C compounds were synthesized and their in vivo distribution pattern characterized. The use of depleted uranium as a pinhole collimator insert was evaluated. A program for labeling compounds with ^{18}F was initiated. (JGB)

25325 NEW, LOW-TEMPERATURE SYNTHESIS OF PLUTONIUM AND URANIUM NITRIDES. Cleveland, J. M.; Bryan, G. H.; Heiple, C. R.; Sironen, R. J. (Dow Chemical U.S.A., Golden, CO). Contract AT(29-1)-1106. Nucl. Technol.; 25: No. 3, 541-545(Mar 1975).

Plutonium and uranium nitrides were synthesized by reacting a solution of the actinide iodide and a solution of sodium, potassium, or calcium in anhydrous liquid ammonia. The precipitate was identified by elemental analysis, infrared absorption, and x-ray diffraction. Nitrides are of interest as fast breeder reactor fuels, in part because of their high thermal conductivity and high metal atom density; however, they have been difficult to prepare and fabricate. This low-temperature synthesis is potentially advantageous because of its simplicity, because the finely divided nitride precipitate is expected to be more easily sintered than nitride prepared by conventional techniques, and because it does not require preparation of the metal as an intermediate step. (auth)

25326 THERMAL PROCESSING OF INTERMEDIATE PRODUCTS PREPARED BY THE SOL-GEL METHOD FOR THE PRODUCTION OF SINTERED URANIUM DIOXIDE SPHERES. Landspersky, H.; Vanecek, I. (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 21: No. 1, 11-17(1975).

Calcination, reduction, and sintering of gels prepared by the sol-gel method were studied for the production of ceramic nuclear fuels in the form of sintered UO_2 spheres. Processes proceeding during thermal treatment in air are similar to those proceeding during thermal treatment of powdered ammonium polyuranate, but they are complicated by the fact that organic compounds incorporated into the gel material during its preparation are released simultaneously with water and ammonia. In argon with 4 to 5% H_2, the decomposition process is similar in the initial stage of decomposition to that of calcination in air, but already at a low temperature the reduction of freshly formed UO_3 starts, which affects further decomposition processes. Values of apparent activation energies of these processes were determined and compared with those obtained previously with powdered ammonium polyuranate. Sintering accomplished in one step in Ar + 4 to 5% H_2 mixture led with gel materials to positive results as far as the final density, sphere shape and outer appearance is concerned. At 1400 to 1500°C and 1 hour's hold up at this temperature, several materials yielded spheres with the density exceeding 95% TD; the variation in thermal processing, e.g., the variation in the rate of temperature increase and its hold up may be expected to lead to

further improvement and perhaps also to the reduction in sintering temperature. (auth)

25327 KINETIC STUDY OF THE CARBOREDUCTION OF URANIUM DIOXIDE. Danger, G.; Besson, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). J. Nucl. Mater.; 54: No. 2, 190-198(Dec 1974). (In French).

The reduction by graphite, in a carbon monoxide atmosphere, of uranium dioxide, $UO_2 + 4C \rightleftharpoons UC_2 + 2CO$ has been studied thermogravimetrically in a pressure range of 60–510 torr from 1709 to 1818°C. The kinetic law is parabolic; solid-state diffusion in the compact dicarbide layer is probably rate-limiting. The rate constant is a linear decreasing function of pressure; this permits an estimate of the equilibrium pressure by extrapolation to zero rate. (auth)

25328 TRITIUM LABELLED ELLIPTICINE DERIVATIVES. Le Goffic, F.; Gouyette, A. (Ecole Normale Superieure, 75–Paris (France)). Compt. Rend., Ser. C; 279: No. 1, 47-48 (1 Jul 1974). (In French).

In methanol containing tritiated water ellipticine salts (pyridiniums) and derivatives are reduced by tritiated sodium borohydride after the usual treatments (hydrogenolysis and aromatisation) the initial products are regenerated with a good total yield, tritium-labelled on carbons 1, 3, and 4. (FR)

25329 ABSORPTION SPECTRA OF PENTAVALENT PROTACTINIUM IN PHOSPHATE SOLUTIONS. Le Cloarec, M. F.; Muxart, R. (Fondation Curie-Institut du Radium, 94–Arcueil (France). Lab. d'Arcueil). Radiochim. Acta; 20: No. 1/2, 7-10 (1973). (In French).

UV and visible absorption spectra of phosphoric solutions of Pa(V) are reported. The influence of hydrogen ion and phosphoric acid concentration were investigated as well as the aging of the solution. (auth)

25330 CHEMICAL EFFECT ON THE $K\alpha/K\beta$ INTENSITY RATIOS IN THE ^{51}Cr–LABELLED CHROMIUM COMPOUNDS. Tamaki, Y.; Omori, T.; Shiokawa, T. (Miyagi Univ. of Education, Sendai). Radiochem. Radioanal. Lett.; 20: No. 4-5, 255-262 (28 Feb 1975).

$K\alpha/K\beta$ intensity ratios in various ^{51}Cr-labelled chromium compounds were determined with a high resolution Si(Li) detector. Necessary corrections of the observed $K\alpha/K\beta$ intensity ratios for various kinds of absorptions were made. The final $K\alpha/K\beta$ intensity ratios are strongly affected by the chemical state of the parent ^{51}Cr. (auth)

25331 ELECTROLYTIC PREPARATION OF ^{99m}Tc HUMAN SERUM ALBUMIN USING TIN ELECTRODES. Narashimhan, D. V. S.; Mani, R. S. (Bhabha Atomic Research Centre, Bombay). Radiochem. Radioanal. Lett.; 20: No. 4-5, 307-316(28 Feb 1975).

A method for labelling human serum albumin with ^{99m}Tc using electrolytically generated tin(II) ions has been developed. The procedure uses tin electrodes for electrolysis and gives high labelling yields. The amount of tin released into the final product was found to be much less than the reported toxic levels. A ready-to-use kit for obtaining sterile ^{99m}Tc human serum albumin is described. (auth)

25332 EVIDENCES OF ION-CLUSTER FORMATION ON THE REACTIONS OF I. T.-ACTIVATED ^{80}Br IN $H^{80m}Br-CH_4$ SYSTEM. Yagi, M.; Kondo, K. (Tohoku Univ., Sendai). Radiochem. Radioanal. Lett.; 20: No. 4-5, 299-305(28 Feb 1975).

The effects of various additives having different dipole moment and the temperature dependence on the reaction of isomeric transition-activated ^{80}Br in the $H^{80m}Br-CH_4$ system have been investigated. It was found that the formation of individual organic products, such as $CH_3{}^{80}Br$ and $CH_2{}^{80}BrBr$, were significantly affected by adding CO or HCl additive to the system, and that the distributions of these products were influenced by the temperature of the experimental system. These results present direct evidences to support the suggestion that the charge complex, $(CH_4\ {}^{80}Br^+)^x$, formed in the primary step forms the ion-cluster with surrounding molecules in the subsequent steps to form the final products. (auth)

25333 URANIUM–HYDROGEN SYSTEM. Northrup, C. J. M. Jr. (Sandia Labs., Albuquerque, NM). J. Phys. Chem.; 79: No. 7, 726-731(27 Mar 1975).

Pressure–composition isotherms have been extended to 680 atm for the uranium–hydrogen system. The present investigation indicates that in contrast to the work of Chevallier, Spitz, and Blum the uranium–hydrogen system retains broad, two-phase plateaus on the pressure–composition isotherms at temperatures as high as 846°. The phase diagram for this system and the calculated thermodynamic potentials are discussed and compared with previous investigations. (auth)

Radioactive Waste Treatment

Refer also to abstracts 25222, 25980, and 26502.

25334 (BNWL-1876, pp 45-47) SEPARATION OF ACTINIDE ELEMENTS FROM RADIOACTIVE WASTE. Wheelwright, E. J. Nov 1974.

In nuclear waste management and transportation quarterly progress report, July–September 1974.

The objective is to develop the technology for removing the biologically significant long-lived radionuclides (principally actinides) from commercial radioactive wastes or during fuel reprocessing so that the bulk of the waste would become radioactively nontoxic in less than 1,000 years. The FY75 objective is to determine the technical feasibility. (auth)

25335 (BNWL-1876, pp 49-58) DECONTAMINATION AND DENSIFICATION OF CHOP-LEACH CLADDING RESIDUES. Dillon, R. L.; Kemper, R. S. Nov 1974.

In nuclear waste management and transportation quarterly progress report, July–September 1974.

Fuel element cladding residues from the chop-leach head end process constitute a low-density, high-surface area metallic waste with a substantial actinide element contamination. The objective of this study is to determine feasibility and methods for removal of long half-life transuranics from the cladding residues and for consolidation of the zirconium and stainless steel residues. The study involves: 1. Selection and laboratory testing of methods for transuranic removal by: (a) aqueous reagents; (b) molten salt reagents; (c) fluxing during melting. 2. Consolidation of the fuel element hulls by melting and casting Zircaloy, stainless steel, Inconel or alloys of the three. 3. Testing and evaluating the consolidated fuel hulls for long-term waste management. 4. Absorption and fixation of tritium into the waste ingots. 5. Consolidation of transuranics removed. (auth)

25336 (BNWL-1876, pp 59-61) WASTE TREATMENT AND HANDLING PROCESSES. Mudge, L. K. Nov 1974.

In nuclear waste management and transportation quarterly progress report, July–September 1974.

The principal program objective is to develop a pyrolysis-incineration process for safe and economical reduction of the volume of alpha wastes by 10- to 50-fold as a precursor to long-term storage and/or disposal. The technical and economic merits of this process will be defined to allow its comparison to other processes being considered for volume reduction of alpha wastes. The program objectives will be pursued via (1) a phased program of bench-scale research leading to supporting pilot plant development activities, and (2) systematic and continuing analytical studies to assess the technical and economic merits of the process. Bench-scale and pilot plant activities will be conducted first with non-contaminated simulated wastes and later with actual wastes from Hanford operations. (auth)

25337 (BNWL-1876, pp 63-72) TRITIUM SEPARATION AND FIXATION. Van Tuyl, H. H.; Burger, L. L. Nov 1974.

In nuclear waste management and transportation quarterly progress report, July–September 1974.

The goals of the program are to investigate isotopic separation as a means of concentrating tritiated aqueous wastes, to consider alternative procedures such as increased recycle of water, and to examine methods of fixing tritiated water for permanent storage. (auth)

25338 PROCESSING AND STORAGE OF RADIOACTIVE WASTES. Sorantin, H. (Institut fuer Strahlenschutz, Seibersdorf, Austria). Umweltschutz–Staedteringung; 9: No. 6, 123-126 (Jun 1972). (In German).

A general view on the treatment of solid, liquid, and gaseous wastes is given. Process methods as incineration, embedding or precipitation, ionic exchange, and evaporation are briefly discussed. Possibilities are mentioned for the treatment of radioactive off-gases. (auth)

25339 SCRUBBER UNIT FOR TRITIUM REMOVAL. Koehler, F. A. Jr.; Craft, B. D.; Ashe, J.; Woltermann, H. A. (Mound Lab., Miamisburg, OH). Contract AT(33-1)-Gen-53. Nucl. Technol.; 25: No. 3, 497-501(Mar 1975).

Mound Laboratory is engaged in the recovery of tritium from waste materials generated at U. S. Atomic Energy Commission sites. A scrubber system for tritium removal was designed and constructed at Mound Laboratory. The solutions to be analyzed are first boiled to dryness, and then baked 1 hr at 500°C using H_2SO_4, HCl, or HNO_3 as a carrier. The vapors from these solutions are passed through (a) a condenser to remove the bulk of the acid vapors, (b) an NaOH scrubber to remove acid fumes, (c) a mist eliminator to entrap fine mist particles, and (d) a

molecular sieve bed to remove all traces of tritiated water. Environmental release is monitored by a Kanne electrometer system, which measures the tritium content of the effluent. Use of the scrubber system yields residues with beta counts of <50 count/min with minimal release of tritium to the environment. (auth)

Radioisotope Production

25340 (AD-787627) DESCRIPTION OF THE METHOD USED TO IRRADIATE SHEAR PINS FOR THE EX161 PRIMER. Interim Report. Murray, K. M. (Naval Research Lab., Washington, D. C. (USA)). Sep 1974. 11p. (NRL-MR-2887). NTIS $3.25.

A method is discussed for producing about 1 nanocurie of ^{22}Na per pin in bulk quantities of aluminum shear pins using the ^{27}Al (gamma, alpha, neutron)^{22}Na reaction. Techniques for insuring uniformity of activation and measuring the profile of the high energy part of the bremsstrahlung beam are also presented. (auth)

25341 (CNEA-380) PREPARATION OF MICROCURIES OF ^{234}Th. Suner, A.; La Gamma de Batistoni, A. M.; Botbol, J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

A procedure for the preparation of microcuries of ^{234}Th from hydrochloric acid solutions of uranium (VI) is described. A solution of uranyl chloride in radioactive equilibrium with ^{234}Th (older than 6 months) and having ^{232}Th as carrier, is percolated through a Dowex 50 W × 8 (H^+) resin bed, wherein is absorbed 85% of Th and some uranium, which is then desorbed with 10 N HCl. The thorium remains in the column and is extracted later with a 0.025 M H_2SO_4 plus 1 M $(NH_4)_2SO_4$ solution. The thorium solution is freed from sulfate by precipitation with ammonia, dissolving the precipitate with 10 N HCl, whose solution is treated with Dowex 2 × 8 resin. The ion exchanger absorbs the anionic impurities and the thorium obtained is of high chemical and radiochemical purity. (auth)

25342 (COO-3521-142) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Proposal No. 1. Cyclotron Facility: Production of Radionuclides, Labeled Compounds and Fast Neutron Beams. Progress Report, May 1, 1973-October 31, 1974. Laughlin, J. S.; Tilbury, R. S.; Kuo, T. Y. T. (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 31 Oct 1974. 29p. Dep. NTIS $4.50.

The production of short-lived radioisotopes in the cyclotron and their incorporation into suitable compounds for use as tracers for scintiscanning or in metabolic studies in patients are discussed. Compounds prepared included: ^{11}C-methane, $^{11}CO_2$, ^{13}N-ammonia, ^{11}C-cyanide. Additional radioisotopes produced included ^{15}O, ^{18}F, ^{73}Se, ^{52}Fe, ^{123}I, and ^{203}Bi. (CH)

25343 (DP-1072) DISSOLUTION OF ALUMINUM-CLAD THORIA. Goodlett, C. B.; Bull, H. III. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Dec 1974. Contract AT(07-2)-1. 36p. Dep. NTIS $4.00.

A reverse codissolution process was developed to dissolve aluminum-clad thoria in production of ^{233}U. In the reverse codissolution process, thoria from a previous dissolving cycle is dissolved in strong acid, then fresh aluminum-clad slugs are added to the partially spent dissolvent and the aluminum is dissolved. The advantages of reverse codissolution are: (1) high initial acid concentration enhances thoria dissolution, and (2) subsequent mercury-catalyzed dissolution of the aluminum reduces acid concentrations sufficiently to allow solvent extraction without requiring feed adjustment by steam stripping. Agitation by either submerged steam coils or air-lift circulators increased the dissolution rates from 0.9 pound ThO_2 per hour per square foot of dissolver bottom to 4.3 and 17.2 lb $ThO_2/(hr\text{-}ft^2)$, respectively. Thoria that had 1 wt % magnesia incorporated during its preparation dissolved, when agitated, at a rate of 69 lb $ThO_2/(hr\text{-}ft^2)$. (auth)

25344 (DP-MS-75-13) PRODUCTION OF BERKELIUM AND CALIFORNIUM. Crandall, J. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 16 Jan 1975. 33p. (CONF-750112-2). Dep. NTIS $4.75.

From symposium commemorating the 25th anniversary of the discovery of elements 97 and 98; Berkeley, USA (20 Jan 1975).

By the end of 1974 about 2 grams of ^{252}Cf and 0.2 gram of ^{249}Bk had been produced in the high flux reactor programs at Savannah River and Oak Ridge and similar quantities of these nuclides were under irradiation. Production methods by accelerators and thermonuclear explosions were also well developed, but have proved a more expensive route to those nuclides which are available from the reactors. Multi-kilogram quantities of berkelium and californium are an eventual possibility from burnup of the byproduct actinides from the power reactor fuel cycles. (auth)

25345 (LF-59) NEW SHORT-LIVED NEUTRON-RICH ZINC AND CADMIUM ISOTOPES PREPARED AND IDENTIFIED BY COMBINED ELECTROMAGNETIC ISOTOPE SEPARATION AND THERMOCHROMATOGRAPHY OF FISSION PRODUCTS. Grapengiesser, B. (Forskningsraadens Lab., Studsvik (Sweden)). 1974. 28p. Dep. NTIS (US Sales Only) $4.50.

Through a combination of electromagnetic isotope separation and thermochromatography in steady state condition, the production of short-lived $^{115-128}Cd$ and $^{75-80}Zn$ has been demonstrated and pure sources of these nuclides, except for the growing-in of daughter activities, were prepared. (auth)

25346 PREPARATION OF THIN SOURCES FROM TRANSURANIUM ELEMENTS BY SPUTTERING MATERIALS WITH FISSION FRAGMENTS. Aleksandrov, B. M.; Baranov, I. A.; Krivokhatskii, A. S.; Tutin, G. A. pp 36-38 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

Irradiation of fissionable material with external fission fragments causes sputtering of the irradiated material by induced fission fragments. This method was used to produce very thin sources of ^{239}Pu, ^{238}Pu, ^{241}Am, and ^{252}Cf. ^{252}Cf was used as the source of the fission fragments. The installation used was sketched and can be used both at atmospheric pressure and in vacuum. The results obtained showed that this method of preparation can be effectively used in those cases where it is necessary to obtain very thin small-grained spectrometric sources on thin film substrates. (JSR)

25347 PRODUCTION OF ^{13}N SOLUTIONS FOR INJECTION BY MEANS OF A MEDICAL COMPACT CYCLOTRON. Crouzel, C.; Comar, D. (CEA, Orsay, France). Radiochem. Radioanal. Lett.; 20: No. 4-5, 273-278(28 Feb 1975).

A method for producing ^{13}N in solution with a medical compact cyclotron is described. ^{13}N was produced by irradiating high-purity carbon dioxide with deuterons. Following irradiation, CO_2 with ^{13}N is condensed in a trap placed in liquid nitrogen. ^{13}N is then separated from CO_2 by pumping with a Toepler pump. At the end of the operation, a bubble of gas (0.3 cm^3) containing 30 mCi of ^{13}N is extracted, from an irradiation of 40 minutes by a 20-μA beam of 9-MeV deuterons. As much as possible of this volume is dissolved in physiological serum, giving the ^{13}N solution an activity of 1 mCi/ml. (auth)

Reactor Fuel Reprocessing

Refer also to abstract 28881.

25348 (DOCKET-50201-161) WEST VALLEY REPROCESSING PLANT. Quarterly Reports for the Period October 1, 1970-June 30, 1973. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 29 Jan 1971. 87p. Dep. NTIS $7.50.

The results of environmental monitoring for ^{131}I, low level liquid effluent monitoring, stack effluent monitoring, and surveillance tests made from Oct. 1, 1970, to June 30, 1973, are presented. (JSR)

25349 (DOCKET-50201-162) WEST VALLEY REPROCESSING PLANT. Safety Analysis Report, Supplement 11. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 20 Dec 1974. 194p. Dep. NTIS $12.75.

Supplement 11 contains responses to USAEC comments and questions on structural design, radiological safety, process safety (text specific and instrumentation), and confinement systems for high level waste contained in the USAEC letter to NFS dated June 28, 1974, and responses to USAEC comments on structural design contained in the USAEC letter dated December 2, 1974, and related to the structural design responses mentioned above. (LK)

25350 (DOCKET-50201-163) WEST VALLEY REPROCESSING PLANT. License CSF-1, Safety Analysis Report, Supplement 12. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 10 Jan 1975. 121p. Dep. NTIS $9.25.

Responses are reported to USAEC questions on hydrological engineering, meteorology, and geology, seismology, and foundation engineering. (JSR)

25351 (DOCKET-50201-164) WEST VALLEY REPROCESSING PLANT. License CSF-1, Safety Analysis Report, Supplement 13. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 27 Jan 1975. 305p. Dep. NTIS $18.25.

Responses are reported to the USAEC questions on the ventilation and process safety of the installation. Revised pages

and replacement drawings for the Safety Analysis Report are also included. (JSR)

25352 (DOCKET-50201-165) WEST VALLEY REPROCESSING PLANT. License No. CSF-1, Environmental Report, Supplement 3. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 12 Feb 1975. 106p. Dep. NTIS $8.50.

The structure, utilities, effluents, and environmental impact of the new installation for the conversion of plutonium nitrate solution to plutonium oxide are described. Revisions to the original report reflecting the plutonium oxide production process and revisions in reflecting new data on the CAP, emergency water supply, and ventilation changes are also included. (JSR)

25353 (IDO-14659) ICPP LABORATORY STUDIES ON A COMBUSTION–NITRIC ACID LEACH PROCESS FOR ROVER FUEL. Decker, L. A. (Phillips Petroleum Co., Idaho Falls, Idaho (USA). Atomic Energy Div.). Nov 1965. Contract AT(10-1)-205. 12p. Dep. NTIS $4.00.

Declassified 28 Aug 1973.

A process is needed to recover the uranium from the uranium carbide-graphite fuel elements such as are being tested for the Rover space reactor program. The process described in this report resulted from laboratory studies using actual specimens of Rover fuel including one irradiated specimen. The studies indicated that a burn-leach process using nitric acid only as the leach reagent would be feasible if combustion temperatures are maintained at or below 800°C. The specimens used in the study were burned in air or air diluted with nitrogen and then the ash was leached with 8M nitric acid. Uranium recoveries of up to 99.8% were obtained from fuel burned at 800°C. (auth)

25354 (KFK-2082) ELECTROLYTIC METHODS IN THE PUREX-PROCESS. Schmieder, H.; Baumgaertner, F.; Goldacker, H.; Hausberger, H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany)). Dec 1974. 108p. (In German). Dep. NTIS (US Sales Only) $8.50.

A 16-stage electrolytic mixer-settler, operating without diaphragms, was constructed on the basis of investigations on corrosion rates and electrolytic mass transfer at different electrode materials. The mixer-settler casing was made of titanium. The Pu–U-separation (1B-Battery) and the Pu back-extraction by electrolytic reduction (2B-Battery) were successfully tested during more than 1000 hours of operation. The mass transfer coefficients obtained for uranium proved that no fundamental difficulties should arise from the scale-up of the apparatus. Experiments with an electrolytic pulse-column showed favorable mass transfer coefficients, which are comparable to those of the tested mixer-settler. Flowcells were constructed and successfully tested on the basis of laboratory experiments concerning the anodic oxidation of plutonium between the cycles of the Purex-process. (auth)

25355 (ORNL-TM-4613) COMPUTER PROGRAMS FOR THE DETERMINATION OF CAPITAL COSTS FOR HTGR-RFDP PROCESS EVALUATION PROJECT. Llewellyn, G. H. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 311p. Dep. NTIS $18.75.

Three computer programs, BAL, CEP, and TCP, have been written to obtain the total capital costs for the HTGR fuel recycling plant concepts in which various methods of processing are used. BAL is a material balance program that calculates the mass flow rate of each stream and the mass throughput to and the product output from each of the 29 processes in the plant. CEP is a capital equipment cost program that calculates the cost functions for each of the processes. The program produces graphical output data through ORGRAPH, expressing capital cost rates as functions of process throughput. TCP is the total capital cost program that interfaces BAL with CEP to provide as output the breakdown of the total capital expenditures between the $^{233}U(23)$ recycle, $^{235}U(25)$ recycle, and initial and makeup (IM) fuel elements. (auth)

25356 OPTIMIZATION OF CAPACITIES AND TIMING OF START-UP OF LARGE REPROCESSING PLANTS. Jauer, H. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)); Kayser, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)); Tillessen, U. (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Grossauheim (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 12, 607-609(Dec 1974). (In German).

Reprocessing is not only a question of economy, it also seems to be necessary with respect to the conditioning of fission products. Bred fissionable fuel is of economical interest with respect to recycling after its purification by reprocessing. This is especially true for the Th-cycle of the HTR, where the U-233, being very valuable and produced with a high conversion rate, may substitute 40% of the highly enriched U-235. Therefore, the question concerning capacity of HTR-fuel reprocessing and refabrication plants as well as the timing of their start-up is an optimization problem, whereby the interest rates for the non-substituted U-235 are of greater influence than in the case of plutonium recycling in the LWR-cycle. Therefore, a computer code was developed for a study on the closing of the HTR fuel cycle, which can be applied easily with only small variations to other reactor systems. (auth)

CONTROLLED THERMONUCLEAR RESEARCH

Plasma Confinement and Heating

25357 (AD-777072) LASER HEATING OF MAGNETICALLY CONFINED PLASMAS FOR X-RAY PRODUCTION. Final Report, 10 April 1972–30 April 1973. Hoffman, A. L. (Mathematical Sciences Northwest, Inc., Seattle, Wash. (USA)). Nov 1973. Contract DNA001-72-C-0218. 159p. (MSNW-73-106-1). NTIS $5.00.

Axial heating of a high density, initially low beta, theta-pinch plasma by 10.6 micrometer radiation was demonstrated. A self laser beam trapping, electron density minimum on-axis has been created and maintained by magnetic field shaping and laser heating. A 10-cm long by 6-mm diameter 5×10^{17}/cc electron density plasma column has been heated from an initial temperature of 10 eV to 100 eV by 50 J of laser energy in 100 nsec. The resulting plasma expansion and on-axis density reduction was measured by holographic interferometry. (auth)

25358 (IPPJ-176) MODEL OF HIGH ENERGY TAIL FORMATION OF AN ION DISTRIBUTION IN TURBULENT PLASMA HEATING. Hatori, T.; Sugihara, R. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1973. 24p. Dep. NTIS (US Sales Only).

Ion heating by strong ion wave turbulence is theoretically considered. It is assumed that the electron temperature T_e and the ion temperature T_i are initially close so that the linear Landau damping of ion waves is fairly strong. It is also assumed that E_e increases in time in a way that a region of the resonant diffusion in velocity space gradually moves to higher velocity region, so that the resonant ions are accelerated for a relatively long time. An equation based on the above model is presented and is analytically solved. Under plausible assumptions one finds that the tail distribution is proportionnal to $\exp(-v/u_0)$, where u_0 is the trapping velocity defined by Dupree. (auth)

25359 ABSORPTION OF MICROWAVE ENERGY IN A PLASMA COLUMN AT HIGH MAGNETIC FIELDS. Kopecky, V.; Musil, J.; Zacek, F. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Phys. Lett., A; 50: No. 4, 309-310(11 Dec 1974).

This paper shows the possibility of the microwave energy absorption in an initial plasma at magnetic fields satisfying conditions $\omega_{ce}/\omega \gg 1$, where ω_{ce} and ω are the electron cyclotron frequency and the frequency of the incident electromagnetic wave. The microwave energy is delivered into the plasma by the cylindrical helical structure. (auth)

25360 TRANSFORMATION OF CONCENTRIC SHOCK COMPRESSION OF A NONHOMOGENEOUS MEDIUM INTO ISENTROPIC COMPRESSION. Kaliski, S. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 22: No. 7-8, 569-577(1974).

Transformation of concentric compression of a plasma ball into quasi-isentropic compression by programmed nonhomogeneity (density) of the body was shown on the grounds of an approximate averaged description to be possible. Similarly to the method of prescribed variability of the external pressure pulse, shock compression can be made an isentropic process, which is essential for problems of laser compression of plasma, with explosion precompression, in particular, where it is difficult to prescribe variability of the explosion pressure. Much better compression indices of plasma can be obtained for the external pulse energy remaining the same as in the case of homogeneous plasma. (auth)

25361 CUMULATION OF OPPOSITE THERMAL WAVES IN LASER PLASMA. Kaliski, S. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 22: No. 9, 783-788(Nov 1974).

The subject of the present considerations is the problem of cumulation of opposite thermal waves generated in solid D-T by laser pulses. An equation is deduced for the temperature increase after collision of thermal wave fronts. This equation is based on the diffusion model for averaged description of the reflected wave, which is a consequence of the fact that the region into which the reflected perturbations propagate is a region occupied by the incident wave. Further analysis is required for the effects connected with the two-temperature character of plasma and the plane character of the process. Cumulation effects are essential for problems of laser microfusion. (auth)

25362 NONMAGNETIC CONTAINMENT OF A DENSE PLASMA. Vekshtein, G. E.; Ryutov, D. D.; Spektor, M. D.; Chebotaev, P. Z. Zh. Prikl. Mekh. Tekh. Fiz.; No. 6, 3-13(1974). (In Russian).

The possibility is considered of containing a thermonuclear plasma at a temperature of about 10^4 eV and density of about 10^{18} cm^{-1} by rigid vessel walls (nonmagnetic containment) rather than by a magnetic field. The specific features of this method of containment include onset of plasma streaming, formation of a dense boundary layer, and increase in the role of the radiation loss from the plasma. Based on a numerical solution of the plasma transport equation, the effect of these features on the energetic life time of the plasma was studied. The results indicate that positive energy losses from the plasma are not catastrophically large and that nonmagnetic containment of a dense plasma is possible in principle. (tr-auth)

25363 COUPLING OF LASER RADIATION INTO PLASMA BY DYNAMIC ABSORPTION CAUSING SUPER-EFFICIENT COMPRESSION. Hora, H. (Australian National Univ., Camberra. Photon Physics Group). Atomkernenergie; 24: No. 3, 187-192(1974).

From 2nd European electrooptic conference; Montreux, Switzerland (2 Apr 1974). 3 figs.; 22 refs.

The refractive index and the absorption constants for laser radiation in plasma are summarized for linear, nonlinear and relativistic conditions. Besides anomalous absorption and that due to instabilities, the dynamic absorption due to nonlinear forces is predominant at high laser intensities and high plasma densities. A new compression scheme is derived, where a transfer of up to 50% of laser energy into kinetic energy of cold imploding thick shells is possible. More than thousand times less laser energy is necessary to reach the same nuclear fusion gains as in the case of gas dynamic ablation. (auth)

25364 GAS DYNAMICS OF A PLASMA IN A SPIRAL MAGNETIC TRAP WITH "POINT" MIRRORS. Vasil'ev, Yu. V.; Mirnov, V. V. Zh. Prinkl. Mekh. Tekh. Fiz.; No. 6, 14-19(1974). (In Russian).

The gas dynamic equations of a dense plasma confined by spiral magnetic fields were derived. The limiting cases of large and small mean free path lengths $\lambda \ll l_0$ and $\lambda \gg lk$, where l_0 is the mirror length, l is the corrugated field, and k is the mirror ratio, were examined earlier. In the present study the intermediate range $l_0 \ll \lambda \ll lk$ was studied. It was shown that in this region the process of field expansion has a diffusion character. The transfer coefficients of the plasma along the magnetic field were calculated. (tr-auth)

25365 THERMAL CONDUCTION EFFECTS IN LASER TARGET INTERACTION. Pert, G. J. (Univ. of Hull, Eng.). Plasma Phys.; 16: No. 11, 1019-1033(Nov 1974).

The role of thermal conduction in modifying the characteristics of steady state deflagration structures in laser-solid target interaction was investigated. It was found that even in the case where the thermal conduction is small, the properties of the flow must be modified to include heat transfer to the expansion fan, and two dimensional gas flow effects. In the case of the thick thermal structure modified scaling laws must be used. (auth)

25366 OPTICAL INVESTIGATION OF A TURBULENT PLASMA. Volkov, Y.F.; Dyatlov, V.G.; Mitina, N.I. Sov. Phys.—Tech. Phys. 19: No. 7, 905-908 (Jan 1975).

Θ—pinch plasma is investigated. For a density $n_i \geq 5 \cdot 10^{14}$ cm^{-3} and ion temperature $T_i \sim 30$ eV there are intense oscillations with electric fields up to 25 kV/cm. These are low—frequency ($\omega \gg \omega_{pe}$) oscillations with vector directed predominantly along the azimuthal plasma current. The plasma turbulence level is of the order of 10^{-3}. (auth)

25367 LINEAR TRANSIENT RESPONSE OF A FULLY IONIZED PLASMA IN A PULSED ELECTRIC FIELD. Istomin, V.V.; Sher, S.P.; Dovgopol, S.P. (S. M. Kirov Ural Polytechnical Institute). Sov. Phys.—Tech. Phys. 19: No. 7, 963-964 (Jan 1975).

A kinetic equation for the one—particle distribution function with a Landau collision integral is used to investigate the linear transient response of a fully ionized plasma in a pulsed electric field. General expressions are obtained for the electric current as a function of time and the energy absorbed by the plasma. Computer calculations are presented in the form of curves of the current and energy; these lead to the conclusion that the transition to the steady state is slower than in a weakly ionized plasma. For this reason, measurements of the electrical conductivity of a plasma can be lower than the Spitzer value if the measurements are not performed in the steady state. (auth)

Plasma Diagnostics

Refer also to abstract 25658.

25368 (AD-778429) TIME-RESOLVES SPECTROSCOPY OF PLASMA INSTABILITIES. Interim Report, 15 Jun 1971–15 June 1972. Paulson, R. F. (Technology, Inc., Dayton, Ohio (USA)). Jan 1974. Contract F33615-71-C-1463. 35p. (ARL-74-0005). NTIS $3.25.

A technique to measure the time-resolved coefficients of emission and absorption in a striated mercury-argon flow discharge is described. The measurement technique utilizes the double path method and photon counting in conjunction with a multichannel analyzer. The double path method simplifies the problems resulting from time varying emission intensities and line widths. The use of photon counting in combination with a multichannel analyzer allows digital data storage which requires a minimal amount of time to achieve the necessary statistical accuracy for the intensity measurements. (auth)

25369 (AD-783511) HOLOGRAPHIC INTERFEROMETRY DEVELOPMENTS FOR DENSE PLASMAS. Final Report, January 1973–January 1974. Murphy, C. G. (Science Applications, Inc., Albuquerque, N. Mex. (USA)). 20 Feb 1974. Contract DNA001-73-C-0041. 88p. (SAI-73-512-AQ). NTIS $4.00.

The necessary parameters for producing interferograms by holography with special attention given to the case of diagnostics for laser-produced plasmas are discussed. The design of a dense plasma interferometric experiment is described. (auth)

25370 (AD-784763) MEASUREMENTS OF EARLY MAGNETIC FIELDS IN LASER PRODUCED PLASMAS. Wegener, B. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1974. 83p. NTIS $7.25.

Thesis.

A plasma was produced by irradiation of an aluminum target with a 280 MW, 25 nsec pulse from a neodymium-doped glass laser. The resulting plasma expanded into an ambient background of 0.00005 torr to 1000 mtorr and was analyzed using floating double probes and magnetic probes. An early magnetic field was observed which arrived at the probe position before the main plasma. The strong reversed field observed at the front of the laser plasma is attributed to the development of an axial electron temperature gradient due to snowplowing of the ambient plasma and to the larger radial density gradient. (auth)

25371 (AD-785238) APPLICABILITY OF ABSORBER-RATIO METHODS TO BEAM–PLASMA SYSTEMS. Gerber, K. A.; Logan, B. G. (Naval Research Lab., Washington, D. C. (USA)). Aug 1974. 14p. (NRL-MR-2859). NTIS $3.00.

Results of calculations are used to determine whether the absorber-film or absorber-silicon detector ratio method of plasma temperature determination is applicable to plasma-electron beam interaction experiments. (auth)

25372 (IPPJ-DT-35) MEASURING SYSTEM WITH PROBE IN QP PLASMA GENERATING EXPERIMENT. Kuroda, T.; Fujiwaka, S.; Matsuura, K.; Ito, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1972. 51p. (In Japanese). Dep. NTIS (US Sales Only).

A probe system was designed in order to obtain information from a plasma column being driven radially with a hydraulic driving mechanism. A motor drive system is required to place a motor fully away from the probe location in order to avoid interference with the magnetic field of the plasma equipment. To evade this difficulty, a hydraulic pump was adopted as the power source. The cylindrical Langmuir probe was adopted to aim at the measurement using a sawtooth wave, that is most the severe condition. The probe was of the cartridge type to make the exchange of the probe comparatively easy. Three measuring methods are available in this probe system. (JA)

25373 (IPPJ-DT-41) DATA PROCESSING OF MAGNETIC PROBE SIGNAL IN TOROIDAL PINCH EXPERIMENT. Mimura, M.; Hirano, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1973. 28p. (In Japanese). Dep. NTIS (US Sales Only).

In axi-symmetrical toroidal pinch (STP-1) experiments, a magnetic probe is conveniently used as it has the advantages of being capable of localized measurement and less expensive, though it has also the disadvantage of requiring insertion into the plasma directly. The computer program to analyze the measured data with the magnetic probe is described. The program consists of two parts: (1) program to make the graph of instantaneous magnetic field distribution in radial direction on a XY plotter using photographs (abscissa is shown in time) taken at each measuring point in radial direction, (CODE-1), and (2) program to make the graphs of magnetic surface, magnetic pressure, plasma pressure, toroidal- and poroidal-current density, stabilization factor and beta, calculated from the above obtained magnetic field distribution graph, applying equilibrium equation and Maxwell's equation, on a XY plotter, (CODE-2). After analyzing procedure is explained briefly, analysis programs and the analysis examples of STP-1 Tokamak mode experiment are described. (JA)

25374 (UCRL-50025-75-1, pp 4-7) X-RAY STREAK CAMERA. McConaghy, C. 1 Feb 1975.

In Electronics Engineering Department quarterly report.

Streak cameras are used to provide time information on very fast changing events. The initial streak cameras consisted of a high-speed rotating mirror which projected the light image of the fast event onto film. The film picture is a "streaked out" version of the event. By measuring the length of the streak on the film and knowing the streak speed, one can determine the duration of the event. This technique has been extended to the electro-optic streak camera. Previous cameras were sensitive to visible and infrared wavelengths; the camera described here is sensitive to x rays. (auth)

25375 (UCRL-50025-75-1, pp 19-23) 2-mm MICROWAVE INTERFEROMETER. Meeker, D. J.; Condit, R. 1 Feb 1975.

In Electronics Engineering Department quarterly report.

A common method for characterizing plasmas is to inject an electromagnetic wave into the plasma and then observe the effect of the plasma on the wave. The plasma both attenuates and phase-shifts the electromagnetic wave, which allows one to determine the collision frequency and free-electron density of the plasma. The maximum detectable electron density is a function of the frequency of the electromagnetic wave; higher frequencies are needed for denser plasmas. To date, microwave systems have been operating in the 1-100 GHz range. This article describes development work to extend this range to 140 GHz. (auth)

25376 CALIBRATED MULTICHANNEL ANALYZER FOR NEUTRAL RECHARGE PARTICLES FOR STUDYING PULSED PROCESSES IN A PLASMA. Koshilev, N. A.; Parfenov, A. G. Zh. Prikl. Mekh. Tekh. Fiz.; No. 6, 40-45(1974). (In Russian).

The construction and calibration are described of a multichannel analyzer for neutral particles according to energy, used for studying the heating of the ion components of a plasma in short-duration processes. The analyzer permits obtaining nine points on a studied energy distribution in one-cycle of operation of the experimental equipment, which makes it possible to exclude the effects of nonrepeatability of a process on the results obtained. The equipment consists of a gas stripping chamber and a nine-channel electrostatic analyzer of ions according to energy and is based on a flat condenser with an angle of entrance of particles to the analyzing field of $\theta = 45°$. Results are given of the calibration of the stripping chamber for hydrogen atoms, H^0, in the energy range 0.3 to 10 keV and for He^0 atoms in the range 1 to 10 keV. Air, hydrogen, and helium are used as conversion gas targets. (tr-auth)

25377 THREE-CHANNEL SPECTROMETER FOR STUDY OF HIGH-TEMPERATURE PLASMA. Nagulin, Yu. S.; Smolyak, E. L.; Afanas'ev, V. A.; Gimushin, I. F. Zh. Prikl. Spektrosk.; 21: No. 6, 1070-1072(Dec 1974). (In Russian).

The optical circuits and the construction of a three-channel spectrometer designed for study of high-temperature plasma are described. The instrumental functions of the device and the trace of the contour of the Hg line with wavelength $\lambda = 546$ nm are reported. (tr-auth)

25378 ORIENTATED PROBE IN A DISTURBED ZONE FORMED BY INTERACTION OF PLASMA STREAM WITH METALLIC SURFACE. Demchenko, P. A.; Krupnik, L. I.; Selemir, V. D. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 11, 1770-1773(Nov 1974). (In Russian).

A modified double electric probe was used to measure the local variations of plasma density in the disturbed zone formed when the plasma stream (with density $n \sim (0.5 \text{ to } 2) \times 10^{14}$ cm^{-3} and velocity $v \sim (0.5 \text{ to } 1) \times 10^{17}$ cm/sec) collides with a plane metallic surface. It is shown that the characteristic size of this zone is 2 cm, which is in a good agreement with the value measured by means of an active corpuscular diagnostic method. No changes in electron temperature near the plane surface were found. Cynamics of the charged particles movement in the disturbed zone is mainly determined by the collision processes of the undisturbed stream particles with the solid and neutrals in the condensation zone. (auth)

25379 SPECTROSCOPICAL DIAGNOSTICS OF A NON-THERMAL He-PLASMA JET. Mauderer, H.; Schmid, G. (Technische Univ. Muenchen (F. R. Germany). Inst. fuer Physikalische Chemie und Elektrochemie). Z. Naturforsch., a; 29: No. 11, 1690-1691(Nov 1974). (In German).

4 figs.; 7 refs. Part of a diploma thesis by Mauderer, H.

The properties of a low-pressure non-thermal He-plasma jet have been investigated. The gas temperature was obtained from the population densities of highly excited He levels. The electron density was determined both from the Stark-effect broadening of some He lines and from the intensities of some forbidden transi-

tions. The radial distribution of electron temperature was found by comparing the computed population densities of the He 3^1P level with the experimental values. (auth)

25380 APPLICATION OF A TUNABLE DYE LASER TO PLASMA DIAGNOSTICS IN A HELIUM PLASMA. Burrell, C. F. College Park, MD; Univ. of Maryland (1974). 96p. University Microfilms Order No. 74-29,757.

Thesis (Ph. D.).

The feasibility of using tunable dye lasers and resonant scattering to probe the local electric field fluctuations in a turbulent plasma is demonstrated in a model type experiment. The method is based on the high frequency Stark effect in helium and involves either a stimulated Raman scattering process or a two quantum absorption in which a laser photon and a plasmon of the turbulent electric field interact. The method is particularly attractive because it offers a local measurement with increased sensitivity over the passive spectroscopic technique. A numerical solution of the equations describing the dynamics of the optical pumping indicates the technique is tenable at least in the parameter range $N_e \sim 10^{12}$ to 10^{14} cm^{-3} and $T_e \sim 1$ to 12 eV. The excitation transfer rate coefficients for inelastic electron-atom collisions transferring excitation between the HeI energy levels n^1S and n^1P (n = 3 and 4) are measured by means of selective excitation with a tunable dye laser. The experimental values obtained are consistent with a theoretical high temperature rate coefficient within the experimental uncertainties. The relaxation rates of the 4^3D, 4^1P, and 3^1P levels were also measured and compared with theory. (Diss. Abstr. Int., B)

25381 SPECTROSCOPIC STUDY IN THE VACUUM ULTRAVIOLET OF A NEON PLASMA IN ELMO. Cobble, J. A. Knoxville, TN; Univ. of Tennessee (1974). 113p. University Microfilms Order No. 75-3582.

Thesis (Ph. D.).

ORNL's ELMO device contains an electron-cyclotron heated plasma in a simple mirror trap. The relative intensities of line radiation in the vacuum ultraviolet for five charge states of neon in ELMO were measured with a calibrated, grazing incidence spectrometer. Theoretical models for the excitation and ionization of atomic systems in the plasma are based on an optically thin, corona approximation in which atom-electron collisions play the main part. The resulting population-balance equations for excited states in the excitation model are employed to measure the temperature of cold electrons which form the background plasma. Once this parameter is known, the density ratios of the various charge states present may be determined. Absolute densities of ions and electrons following from pressure measurements are next presented. Comparison of experimental results with the theoretical ionization model permist the estimation of a particle containment time and an ion temperature. Calculated plasma parameters are consistent with previous measurements of these variables when such measurements exist, and there is qualitative agreement with the estimates when no other assessment is available. (Diss. Abstr. Int., B)

25382 FINITE ION CYCLOTRON RADIUS EFFECTS UPON THE ION PROBE CURRENT. Peter, G. (Univ., Dusseldorf); Sato, M. J. Phys., D (London); 7: No. 18, 2536-2540(11 Dec 1974).

Resonant effects upon the ion current to electrical probes in a magnetic field are presented. When the ion cyclotron radius becomes equal to an even fraction of the distance between the double probes, or between the probe and the wall, a sudden decrease or increase in the ion current collection by the probes takes place as a result of resonant plasma depletion or supply between the interacting parts (ion cyclotron radius resonance). (auth)

25383 PULSED IONIZATION CHAMBER TECHNIQUE FOR MEASUREMENT OF RECOMBINATION RATE OF PLASMAS. Kim, S. H. (Hang Yang Univ., Seoul). J. Korean Nucl. Soc.; 6: No. 4, 253-259(Dec 1974).

The output signal voltage of the pulsed ionization chamber (PIC) was measured for a range of electron density (10^{13} to 10^{17} m^{-3}) of the ^3He plasmas. This experimental data was in excellent agreement with the theory including space charge effects. As an application of the PIC techniques, two-body recombination coefficients were obtained with electron densities measured from output signal voltage of the PIC. These values as a function of pressure were in good agreement with theoretical predictions and ranged from 5×10^{-14} to 3×10^{-13} (m^3/sec) at 300°K for 1 to 10 atmospheric ^3He plasma. (auth)

25384 EXPERIMENTAL STUDY OF A STATIONARY LASER-SUSTAINED AIR PLASMA. Keefer, D.R. (University of Florida, Gainesville, Florida 32601); Henriksen, B.B.; Braerman, W.F. J. Appl. Phys. 46: No. 3, 1080-1083 (Mar 1975).

An experiment was performed to determine the temperature distribution within a stationary plasma in atmospheric air produced by a continuously operating CO_2 laser. A peak temperature of 17000 °K (±5%) was found to exist at a point 1.1 cm ahead of the focal point. The radiation surrounding the hot plasma core was found to consist primarily of the first negative system of nitrogen. (auth)

25385 MEASUREMENTS OF HIGH-CURRENT RELATIVISTIC ELECTRON DIODE PLASMA PROPERTIES WITH HOLOGRAPHIC INTERFEROMETRY. Kelly, J.G.; Mix, L.P. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 46: No. 3, 1084-1090 (Mar 1975).

Double-exposure interference holography has been used to measure the temporal and spatial dependence of plasma densities and velocities in relativistic electron beam diodes. In this paper some of the physics revealed by a detailed analysis of holograms from one such diode is presented. Abel inversion of holograms taken on the Reba accelerator (100 kA, 1.5 MV) incorporating a 0.6-cm-diam glass rod cathode show the axial and radial structure of the diode plasmas. Finge-shift analysis has yielded densities of $5\times10^{17}-5\times10^{19}$ electrons/cm^3, and magnetohydrodynamic pressure balance implies a plasma temperature of about 0.3 keV. In addition, exposure variation of the fringe pattern and motion of plasmas between pictures taken at different times during the pulse have indicated plasma velocities vs spatial position that vary from 10^6 to 10^7 cm/sec. (auth)

25386 PROBE AND SPECTROSCOPIC MEASUREMENTS IN A HIGH-DENSITY DC ARGON ARC PLASMA. Pasternak, A.W.; Offenberger, A.A. (Department of Electrical Engineering, The University of Alberta, Edmonton, Canada). J. Appl. Phys. 46: No. 3, 1135-1140 (Mar 1975).

A steady-state magnetized argon arc plasma device operating in the multi-Torr pressure region is described. Diagnostic techniques involving electrostatic probes and spectroscopic methods are discussed and subsequent information on plasma arc parameters is presented. Electron densities of $\sim2.5\times10^{15}$ cm^{-3} and electron temperatures of ~3.5 eV are derived from probe data, while Ar II Doppler line broadening and Zeeman line splitting yield ion temperatures of ~2.0 eV and peak magnetic field strength of ~2.5 kG. (auth)

25387 MULTICHANNEL DIGITAL SPECTROMETER FOR MEASURING THE ION TEMPERATURE IN A RECURRENT PLASMA. Clement, M.; Moulin, B.; Stevenin, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service d'Ionique Generale). Rev. Phys. Appl.; 9: No. 4, 743-748(Jul 1974). (In French).

A multichannel digital spectrometer has been designed for the evaluation of the ionic temperature in recurrent plasma. The Fabry-Perot interferometric disperser, the 12 spectral channels, and the digital system for storage and output of the results were chosen because of the high sensitivity requirements (very weak light from the plasma) and the flexibility of the digital electronics. The problem of error given by a multichannel spectrometer is discussed and compared to the experimental results obtained after smoothing. Finally, the first results of measurements from the CIRCE 25 kW device are presented. (FR)

Plasma Kinetics (General)

25388 (AD-775087) RESEARCH CONCERNING X-RAY EMISSION OF MAGNETOACTIVE PLASMAS. Final Report. Manley, O. P. (Visidyne, Inc., Burlington, Mass. (USA)). 3 Jan 1974. Contract F44620-70-C-0093. 27p. (VI-221; AFOSR-TR-74-0182). NTIS $4.50.

The applicability of two distinct approaches to the problem of structural stability of optically thin hot radiating plasma was investigated. It was found that by exploring the properties of the simple isotropic model that: (1) topological methods lead to simple diagrams from which stability may be easily determined; (2) these methods also yield approximations useful in estimating the solutions applicable beyond the point of instability; and, (3) some concepts of non-equilibrium steady state thermodynamics have been found applicable in studying the behavior of radiating plasmas. In particular, while the simple criterion of minimum free energy is inadequate for determining system stability under small perturbations, an extended definition of entropy production was found to be equivalent to a Liapounoff function for the system. (auth)

25389 (AD-784850) USE OF PLASMA ACCELERATORS IN TECHNOLOGY. Grishin, S. D.; Kozlov, N. P. 2 Aug 1974. Translated by C. T. Ostertag, Jr. from pp 15-25 of Plazmennye Uskoriteli, 1973. 22p. NTIS $3.00.

Three basic directions of the practical use of plasma accelerators are discussed: the use of plasma accelerators in industry; the use of plasma accelerators in experimental techniques; and the use of plasma accelerators in astronautics. (auth)

25390 (AD-784945) CONTROL SYSTEM FOR ADVANCED PLASMA ENERGY AND PROPULSION SOURCE. Final Report. Hickok, R. L.; Jennings, W. C. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Plasma Dynamics Lab.). Mar 1974. 9p. (RPDL-74-3; AFOSR-TR-74-1297). NTIS $3.00.

An ion beam probe was used to measure the density, space potential, and electron temperature in a hollow cathode arc and the results compared with Langmuir probe measurements. Feedback stabilization of a coherent instability, using an amplitude modulated carrier frequency that is inductively coupled to the plasma, was demonstrated. (auth)

25391 (AD-785115) DYNAMICS OF THE CURRENT SHEATH IN A PULSED COAXIAL INJECTOR. Valkov, Yu. A.; Molchanov, V. S. 21 Aug 1974. Translated by C. T. Ostertag, Jr. from pp 233-234 of Plazmennye Uskoriteli, 1973. (FTD-MT-24-1086-74). 24p. NTIS $3.00.

Pulsed coaxial plasma accelerators are discussed. Results are given of the measurement of the distributions of electrical and magnetic fields in the entire space of the channel and for all points in time, density distribution of the inert gas, density of charged particles, and luminous intensity of lines H alpha, H beta, and CII. By calculations the distributions of temperature, current density, conductivity, and velocities of ions and electrons were obtained. (auth)

25392 (AD-786885) TWO-DIMENSIONAL HYDRODYNAMICAL SIMULATION OF AN ELECTROMAGNETIC IMPLOSION DEVICE. Technical Report, Jul 1972 - Feb 1973. Rhoades, C. E. Jr.; Taggart, K. A. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Mar 1974. 131p. (AFWL-TR-73-267). NTIS $5.75.

The electromagnetic implosion device which is geometrically a z-pinch is simulated by a two-dimensional Lagrangian hydrodynamical computer code. The usual Lagrangian differencing scheme problem of mesh distortion is overcome by a coordinate orthogonalization scheme. The physics, as well as the numerical techniques of the simulation, are described. It is also intended as a user's manual for the computer code. (auth)

25393 (AD-787419) ENERGY CHARACTERISTICS OF COAXIAL PLASMA SOURCE. Belikov, A. G.; Goncharenko, V. P. 3 Oct 1974. Translation of pp 200-203 from Plazmennye Uskoriteli, N. P., 1973. (FTD-HT-23-1076-74). 10p. NTIS $3.25.

25394 (AD-787783) HIGH TEMPERATURE PLASMA RADIATION: A STUDY OF THE RECOMBINATION CONTINUUM OF ARGON IN THE ULTRAVIOLET AND OF THE CONDITIONS FOR EQUILIBRIUM IN NITROGEN ARCS. Final Report, 1 July 1972 - 1 September 1973. Burnham, R. L.; Shumaker, J. B. (National Bureau of Standards, Washington, D. C. (USA)). Jun 1974. 28p. (ARL-74-0061). NTIS $3.75.

The absolute intensity of the recombination continuum of argon was measured at wavelengths between 150 and 300 nm. The continuum radiation was produced in constricted arcs operating in argon at atmospheric pressure. The measurement of the absolute intensity of the continuum at wavelengths between 170 and 300 nm was facilitated through the use of a deuterium discharge lamp as a calibrated source of spectral radiance. Nitrogen arc measurements of the intensity of the 4915 Å to 4935 Å NI doublet and of the 3995 Å NII line show that local thermodynamic equilibrium cannot be assumed in nitrogen arcs at electron densities below 10^{17}/cc. Below this point, the results suggest that gas and electron temperatures differ significantly and that ground states are overpopulated with respect to upper electronically excited states. (auth)

25395 FORMATION OF T LAYERS IN THE PROCESS OF DECELERATION OF PLASMA BY A MAGNETIC FIELD. Samarskii, A. A.; Dorodnitsyn, V. A.; Kurdyumov, S. P.; Popov, Yu. P. (Inst. of Applied Mathematics, Moscow). Dokl. Akad. Nauk SSSR; 216: No. 6, 1254-1257(21 Jun 1974). (In Russian).

An experiment was previously described on the deceleration of plasma bunches by a magnetic field in the channel of the rel'sotron in which a very clear inhomogeneous structure formed by alternating hot and cold layers of gas was observed. This process was numerically calculated. The calculations showed that a system of T layers appeared in the flow. The agreement of calculated and experimental results lead to the assertion that in the experiment the appearance of T layers was detected. (JSR)

25396 MONTE-CARLO CALCULATION OF ELECTRON BEAM FORMATION IN CROSSED FIELDS. Roshal, A. S.; Leitan, V. A. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 10, 1553-1560(1974). (In Russian).

The method and results of numerical modelling of formation of an electron beam in crossed fields are described. The influence of the model parameters on the results of modelling was investigated. It is shown that the characteristics of the formed beam is essentially dependent on the initial conditions on the cathode. (auth)

25397 STATIONARY SPECTRAL ENERGY DENSITY OF TURBULENT PLASMA NOISES. Alexandrov, V. V.; Pustovalov, V. V.; Silin, V. P.; Stenchikov, G. L.; Tikhonchuk, V. T. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 10, 1455-1460(1974). (In Russian).

The structure and thickness of transient layers between turbulent and laminar regions of the plasma noises were determined. A uniformly valid representation of the spectral density of the noise energy was found. The analogy of the considered problem with the problem of finding the form of the turbulent region in the theory of the turbulent liquid motion is discussed. (auth)

25398 FLOW OF A WEAKLY IONIZED GAS BETWEEN PARALLEL COLD WALLS WITH PARABOLIC VELOCITY PROFILE. Puspak, S. N.; Srivastava, K. M. (Univ. of Jodhpur, India). Proc. Indian Acad. Sci., Sect. A; 80: No. 5, 241-248(Nov 1974).

Ambipolar diffusion between flat cold insulating walls of a weakly ionized gas which flows in the direction parallel to the walls with parabolic velocity profile was investigated theoretically. It was found that: (1) the patched velocity of linear and nonlinear regions tends to $1/\sqrt{2}$ of the thermal velocity; (2) the thickness of the nonlinear region with parabolic velocity profile is found to be less than that of Shioda who considered uniform steaming (J. Phys. Soc. Japan, 1969, 29, 197); and (3) the number density and the electric potential approximations in the sheath edge do not depend upon x, the coordinate in the streaming direction. (auth)

25399 STATIONARY ACCELERATION OF AN ALKALINE PLASMA AT THE OUTER JUNCTIONS OF THE ELECTRICAL AND MAGNETIC FIELDS. Babkin, G. V.; Grishin, S. D.; Zhirnov, V. A.; Kellin, S. S.; Potapov, A. V. Zh. Prikl. Mekh. Tekh. Fiz.; No. 6, 20-30(1974). (In Russian).

The results of experimental studies on electromagnetic acceleration of an alkaline plasma in one- and two-step accelerators are reported. The nature of the discharge in accelerators with ceramic and metallic walls was studied. The number of elements of a metallic wall needed for preventing rupture was determined. The thrust and other features of different constructions were determined and compared with regard to operating capacity and efficiency. (tr-auth)

25400 SOME PROPERTIES OF PLASMA OF SHF DISCHARGE EXCITED BY MILLIMETRIC WAVES. Bryukhovetskii, A. S.; Martynyuk, S. P.; Motornenko, A. P. (Inst. of Radiophysics and Electronics, Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 8, 1320-1326(Aug 1974). (In Russian).

Properties were studied for plasma of gas discharge excited by a continuous-action generator of a millimetric waves range (λ = 8.5 mm) and power to 20 W in Ar of high purity at pressures of 0.01 to 1 atm. Under these conditions, the SHF gas discharge plasma is shown to be cold and highly nonequilibrium within the whole pressure range studied. The charged particle concentration is 10^{13} to 10^{14} cm^{-3} at gas temperature below 800°K and electron temperature sometimes as high as gas temperature. High energy capacity and possibility of creating conditions for a preferable scattering of the input power for optic radiation of atoms and molecules are distinctive features of a stationary millimetric discharge cold plasma. (auth)

25401 FORMATION OF NEGATIVE ION IN GAS DISCHARGE. Bel'chenko, Yu. I.; Dimov, G. I.; Dudniko, V. G.; Ivanov, A. A. (Inst. of Nuclear Physics, Novisibirsk, USSR). Dokl. Akad. Nauk SSSR; 213: No. 6, 1283-1285(21 Dec 1973). (In Russian).

Although the formation of negative ions by collision of electrons with molecules or molecular ions of hydrogen can be considered as a potential source for the production of intense H^- beams, the current is low. Currents up to 0.75 amp/cm^{-2} were obtained from the hydrogen plasma of high-current discharges in crossed fields with plane geometry of the discharge chamber with cold cathodes. Higher currents of up to 3.7 amp/cm^2 were obtained after the addition of Cs vapor to the discharge. It was assumed that the intense current was explained by the emission of negative ions from the cathode. This assumption was studied and the factors affecting the intensity of the H^- beam were determined. (JSR)

25402 POLARIZATION LOSSES OF A FAST HEAVY PARTICLE IN PLASMA PLACED IN A WEAK HF FIELD. Markeev, B. M.; Moiseev, B. S. (Inst. of Mechanical Problems, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 9, 1404-1407(1974). (In Russian).

The polarization loss of heavy particles placed in a weak hf field was calculated for the case where the dispersion law of the non-perturbed plasma is preserved but the changes in its dissipative properties is considered. (JSR)

25403 POSSIBILITIES OF PLASMAS ROTATING AT SUPERCRITICAL VELOCITIES. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm). Phys. Scr.; 9: No. 3, 189-192(Mar 1974).

It is likely that the velocity limitation observed in some types of rotating plasma devices is caused by an enhanced plasma-neutral gas interaction at the end walls bounding the plasma in the magnetic field direction. If the mechanism underlying the interaction is due to some process which forms anomalous azimuthal electric fields, a short-circuit of the latter would eliminate the velocity limitations. If these predictions are true, new possibilities will open up in the use of rotating plasma. In particular, the power losses due to ions and electrons escaping from a hot isotropic plasma through the magnetic mirror ends can then be kept small enough to balance the thermonuclear power at technically realizable beta values, plasma densities, and magnetic field strengths. At the same time such a strong confinement can only be achieved by very large centrifugal forces, rotational velocities and applied voltages, the technical feasibility of which has to be further examined. (auth)

25404 IMPROVEMENTS IN AND RELATING TO HALL CURRENT ACCELERATORS. Cole, H. (to United Kingdom Atomic Energy Authority). British Patent 1,365,672. 4 Sep 1974. Filed date 28 Jul 1970. 8p.

A Hall current accelerator is described that comprises an inner core and an outer angular magnetizable member which together define a passage of annular cross section. The windings of the core produce a magnetic field directed transversely to the annular passage. An anode and a cathode are located at opposite ends of the passage for acceleration of ions along the passage, and means are provided for modifying the magnetic field in the annular passage so as to cause ions traveling along the passage to be directed in a direction substantially parallel to the walls of the core and the member defining the passage. Means may be provided for producing an auxiliary magnetic field arranged to offset any motion of the ions tending to urge them towards the walls of the passage. Inner and outer magnetizable members may be provided to define an annular gap through which ions are made to pass by application of an electric field longitudinally of the gap; the inner member is movable longitudinally with respect to the outer member, so as to vary the magnetic field configuration and the electrostatic focusing of the accelerator, to offset any tendency of the ions to move towards the walls of the gap. (UK)

25405 ABSORPTION OF LASER EMISSION IN THE LOW-TEMPERATURE REGION. Burakov, V. S. pp 316-345 of Kvantovaya Elektronika i Lazernaya Spektroskopiya. Minsk; Nauka i Tekhnika (1974). (In Russian).

A study of the principles governing interaction of powerful laser emission with plasma formations, leading to heating of these formations and change of absorption capacity was made. The plasma forms examined had different initial parameters (chemical composition, temperature, electron concentration). Intracavity methods are described for determining small changes in the coefficient of absorption of the plasma from a change in the pulse recurrence rate of the emission; these methods have incomparably higher sensitivity than extracavity methods based on measuring the amplitude values of the laser emission pulses. Of particular interest is plasma probing by laser emission pulses of various durations and spectral frequencies. (Referativnyi Zh.)

25406 INTERACTION BETWEEN A RELATIVISTIC ELECTRON BEAM FILLING IN PART OF A WAVEGUIDE DISSIPATIVE PLASMA. Grigor'ev, V. P.; Shulaev, N. S. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 11, 1605-1609(1974). (In Russian).

A relativistic electron beam interacting with a dissipative plasma filling a waveguide of the radius R is considered on the assumption that the beam radius does not coincide with the waveguide ($r_0 < R$) and the external longitudinal magnetic field is applied to the system. The spectrum of electrostatic oscillations is determined. The maximum increments, taking into account both strong and weak energy dissipation, are calculated. The conditions of advantageous excitation of the considered instabilities are obtained. It is shown that the beam electron dispersion over the energies results in stabilization of instabilities and existence of critical currents. The estimations are presented of applying the given approach to consideration of interaction between a beam and plasma. (auth)

25407 STABILITY OF AN ANISOTROPIC PLASMA JET. Srivastava, K. M. (Kernforschungsanlage, Juelich, Ger.). Indian J. Phys.; 48: No. 8, 723-730(Aug 1974).

The Chew–Goldberger–Low equations in the cylindrical geometry were used to study the stability of an incompressible, resistive and anisotropic plasma jet surrounded by a nonconducting gas. The dispersion relation for axisymmetric perturbations was obtained and certain asymptotic cases were discussed analytically. The dispersion roots were also obtained numerically with the help of computer. It was observed that the frequency of oscillation increases as $R^2 = p_{||}/p_{\perp}$, increases. The frequency of oscillation n also increases with λ (the density of the jet to the density of the surrounding gas) and also with $\eta^* = \eta R/(c_{||} a^2)$. (auth)

25408 STEADY STATE OF ELECTRONS IN A STRONG ELECTRIC FIELD. Alekseev, B. V.; Nesterov, G. V. (Computer Center, Moscow). Dokl. Akad. Nauk SSSR; 215: No. 2, 307-308 (11 Mar 1974). (In Russian).

The spatial-homogeneous steady state of electrons, constituent impurity in the neutral gas $n_e \ll n_a^*$, in a strong magnetic field was examined. The algorithms for the numerical solution by the Monte Carlo method were given. It was concluded that a precise solution of the problem lies between the solutions of Dryuvestein and Braglia. (JSR)

25409 INSTABILITY OF INTENSITY DISTRIBUTION OF A LASER BEAM IN A PLASMA. Sodha, M. S.; Sharma, R. P.; Tripathi, V. K. (Indian Inst. of Tech., Delhi). J. Phys., D (London); 7: No. 18, 2471-2478(11 Dec 1974).

The growth of a perturbation in the intensity distribution of a two-dimensional Gaussian beam in a plasma was studied. When the beam travels in the self-made uniform waveguide (i.e., when the power of the beam is equal to the critical power for self-focusing) the intensity distribution is stable. For beams converging on account of self-focusing the amplitude of perturbation increases much faster with distance than the axial amplitude in the absence of perturbations. In a medium with saturating nonlinear dielectric constant, the maximum growth rate of perturbation occurs at an optimum value of the beam power. The optimum power depends on the nature of electron scattering, when the nonlinearity of the dielectric constant is caused by the heating of the carriers by the beam. The growth of a two-dimensional Gaussian perturbation in a plane beam of uniform intensity was also analyzed. (auth)

Plasma Kinetics (Experimental)

25410 (AD-783230) RESEARCH ON SHORT DURATION PULSED RADIATION SOURCES. Interim Scientific Report, 1 June 1973–28 February 1974. Fischer, H. (Technische Univ. Darmstadt (F. R. Germany)). Apr 1974. 24p. (EOARD-TR-75-4). NTIS $3.00.

A nitrogen laser which combined a "Nanolite" pulser with a resonator geometry resulted in a low threshold (3.3 kV) and a 100 kW laser output in the case of a 14 kV pulse voltage. Thus the energy conversion efficiency rose to 0.35%. The beam divergence was reduced to approximately 1 mrad by the resonator. This represents considerable progress in regard to efficient, low voltage, and high repetition rate nitrogen laser operation. The study to correlate soft x-ray spots with the hard radiation in a 1 kJ plasma focus showed that field structures leading to the appearance of soft x-ray spots are always present in this plasma focus. These field structures represent m = 0 plasma instabilities and do have a direct influence upon the observed neutron emission. (auth)

25411 ION COMPOSITION OF DISCHARGE NITROGEN PLASMA. Przhonskii, A. M. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 11, 1892-1896(Nov 1974). (In Russian).

The ionic composition in plasma of the glow discharge positive column with cold molybdenum electrodes in molecular nitrogen was studied by means of mass-spectrometric analysis. At the same time the electron concentration n_e, electric field intensity E, as well as the electron distribution function by energies $f(E_e)$ are determined by means of the sound procedure. The measurements are carried out at nitrogen pressures of p = 0.1 to 1.0 mm Hg and discharge currents J_p = 10 to 60 mA ($n_e = 10^9$ to 10^{10} cm^{-3}). In the whole region of the parameter changes, the ions N^+, N_2^+, N_3^+ and N_4^+ were observed; the dependences of a relative content of every type of the ions on the conditions in plasma are presented. On the basis of the results obtained the conclusions are made on possible formation processes of the ions. (auth)

25412 COMPOSITION, ELECTRICAL CONDUCTIVITY, AND TOTAL RADIATION OF NITROGEN PLASMA. Neuberger, A. W.

(Deutsche Forschungs- und Versuchsanstalt fuer Luft-und Raumfahrt, e.V., Porz-Wahn, Ger.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 13: No. 1, 3-4(Jan 1975).

From 8th thermophysics conference; Palm Springs, CA (16 Jul 1973).

Methods to calculate the composition, the electrical conductivity and the total radiative source strength of nitrogen plasma at temperatures up to 30,000°K are presented. It is supposed that the plasma is in the state of local thermodynamic equilibrium. At a pressure of 1 atm, the electrical conductivity and the continuum radiated power, calculated in the present paper, are essentially in better agreement with experimental data than other known theoretical results. A semiempirical equation is presented which makes it possible to take the line radiation into account in calculating the total radiative source strength. This equation makes possible the extrapolation of the line radiation with respect to pressure and temperature. (auth)

Plasma Kinetics (Theoretical)

25413 (AD-781738) ANALYTIC SOLUTIONS FOR INITIATION OF PLASMA ABSORPTION ABOVE LASER-IRRADIATED SURFACES. Laser Effects Calculations. Quarterly Report, February-June 1974. Pirri, A. N. (Physical Sciences, Inc., Wakefield, Mass. (USA)). 31 May 1974. Contract N00014-74-C-0207. 50p. (PSI-TR-8). NTIS $3.25.

A program to obtain analytic solutions for the effects of vapor and air absorption, and the subsequent onset of plasma shielding, on the radiation that impinges upon a laser-irradiated surface has been initiated. The problem is the determination of the time scale for ignition of a laser supported absorption wave as a function of laser intensity, material, spot size and wavelength. It is shown that over a range of intensities the vapor properties up to the time for ignition can be calculated by uncoupling the heating from the gas dynamics. The time history of the heating effects is obtained by doing a perturbation upon the flow field. The flow is either one-dimensional planar or two-dimensional axisymmetric depending upon the ratio of an appropriate absorption time scale to a characteristic flow time. (auth)

25414 (AD-785236) ANOMALOUS DC PLASMA RESISTIVITY DUE TO ION-ACOUSTIC TURBULENCE. Final Report. Orens, J. H.; Dawson, J. M. (Naval Research Lab., Washington, D. C. (USA)). Aug 1974. 138p. (NRL-MR-2850). NTIS $4.75.

A multidimensional computer simulation study was made of the ion-acoustic instability (the relative electron-ion drift velocity is less than the electron thermal velocity) in the presence of collinear constant electric and magnetic fields. The anomalous dc resistivity due to its turbulence as a function of both these external fields was studied. The constant electric field is in a regime greater than the Dreicer critical limit, but much less than a field which would accelerate an average electron to its thermal velocity in less than an ion plasma time. (auth)

25415 (AD-787034) EFFECT OF LOCALIZED ELECTRIC FIELDS ON THE EVOLUTION OF THE VELOCITY DISTRIBUTION FUNCTION. Morales, G. J.; Lee, Y. C. (California Univ., Los Angeles (USA). Plasma Physics Group). Sep 1974. 20p. (PPG-190). NTIS $3.25.

The interaction between charged particles and sharply localized fields was investigated. The random particle scattering is described by a Fokker-Planck equation whose time-dependent solution exhibits the formation of a highly populated superthermal tail. (auth)

25416 (CEA-CONF-2776) TURBULENT COLLISIONS, BALLISTIC TERMS AND ASYMPTOTIC MASTER EQUATION FOR VLASOV PLASMA TURBULENCE. Misguich, J. H.; Balescu, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); Brussels Univ. (Belgium)). 1974. 4p. (CONF-741024-5). Dep. NTIS (US Sales Only) $4.00.

From 2nd international conference on plasma theory; Kiev, USSR (28 Oct 1974).

From the work of Dupree, one knows that a description of turbulence in Vlasov plasmas has to take into account the influence of the turbulence itself on the elementary propagator. To go beyond the free propagator which is used in the quasi-linear (QL) theory, Weinstock has considered the fluctuating Vlasov equation and derived an exact non-Markovian equation. The method used here takes advantage of exact properties of non-commuting propagators, and avoids usual particle trajectory calculations. A general stochastic treatment of the fluctuating Vlasov equation leads one to a general result which consists in an apparently Markovian form of the Weinstock equation. (MOW)

25417 (IPPJ-180) FREE BOUNDARY MHD EQUILIBRIA IN AXISYMMETRIC TORI. Suzuki, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1973. 25p. Dep. NTIS (US Sales Only).

A method of numerical computation is presented to obtain the equilibrium configurations in axisymmetric tori with the ideally conductive shells of arbitrary cross-sections and/or with control field coils. In this method an artificial function $S(\psi)$ is introduced, which makes it possible to combine the equilibrium equations in the plasma and the equation for the vacuum into one equation. The alternating direction implicit method coupled with the Marder-Weitzner iteration scheme is used to solve the combined equilibrium equation under the boundary condition given on the shell. The continuity conditions at the plasma-vacuum interface are satisfied automatically in the obtained solutions. Some results of the computation are illustrated for cases where the shell shapes are circle, square, rectangle and finger ring type, respectively, and for a case with a ring coil placed inside the square shell. (auth)

25418 (TRITA-EPP-74-11) CHANGES OF VARIABLES IN KINETIC THEORY. Dahlberg, E. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Elektronfysik). Mar 1974. 28p. Dep. NTIS (U. S. Sales Only) $4.50.

It is stressed that changes of variables in kinetic theory can and should, contrary to a widespread practice, be effected within the bounds of mathematics. Thus, an appropriate and systematic use of a well defined set of collision variables allows a straightforward, concise, and comprehensible presentation of typical transformation results, e.g., Boltzmann's collision term, its adaptation for electrons in a cold gas, and Enskog's symmetric-kernel form for the linearized equation. It is also shown how the Allis and Allen form of the left number of Boltzmann's equation (suitable for cases with cylindrical symmetry) can be given a correct derivation and interpretation. (auth)

25419 THEORY OF BEAMS MOVING WITH ACCELERATION. Buts, V. A. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 10, 1561-1567(1974). (In Russian).

It is shown that an accelerated moving beam is unstable with respect to excitation of both longitudinal and transverse waves. With a periodic change in the beam velocity, the maximum increment occurs in the presence of double parametric resonance. The relation between longitudinal and transverse waves is shown to lead to the instability having the greatest increment. (auth)

25420 NEW APPROACH TO A STRONGLY COUPLED ELECTRON PLASMA. Golden, K. I. (Northeastern Univ., Boston); Kalman, G.; Silevitch, M. B. Phys. Rev. Lett.; 33: No. 26, 1544-1547(23 Dec 1974).

A new approach to strongly coupled plasmas is proposed by a scheme linking the linear and quadratic polarizabilities through a self-consistency requirement. The ingredients of the theory are (a) replacement of the nonequilibrium two-particle correlation function by its velocity average; (b) the connection between the nonequilibrium two-point function and the equilibrium three-point function; (c) the link provided by the nonlinear fluctuation-dissipation theorem between the quadratic polarizability and the three-point function.

25421 LIMITING CURRENT FOR HOLLOW ROTATING BEAMS. Poukey, J. W.; Freeman, J. R. (Sandia Labs., Albuquerque, NM). Phys. Fluids; 17: No. 10, 1917-1918(Oct 1974).

A theoretical limit is derived for the z-directed current which can be transmitted through a conducting boundary by a hollow bean of electrons. The result generalizes previous work, and is supported by computer simulations. (auth)

25422 ELECTROMAGNETIC RESPONSE OF A QUANTIZED MAGNETOPLASMA IN TWO AND THREE DIMENSIONS. Orman, M. Hoboken, NJ; Stevens Inst. of Tech. (1974). 316p. University Microfilms Order No. 75-2813.

Thesis (Ph. D).

A detailed analysis of Landau quantization effects in the dynamic nonlocal RPA magnetoconductivity tensors of two- and three-dimensional solid state plasmas was carried out, and explicit evaluations were obtained for all wave-vectors, all magnetic field strength regimes, and for both degenerate and nondegenerate statistical regimes. Magnetic field effects in the plasma-wave spectrum of inversion layers were investigated using the two-dimensional magnetoconductivity tensor. Local inversion layer plasma modes were analyzed in detail, with explicit evaluations obtained in the low-field limit, the high-field limit, and the electrostatic limit. Furthermore, nonlocal Bernstein-type plasma modes were evaluated for two-dimensional plasmas. The bulk plasma-wave dispersion relation (three dimensional) was investigated in the

quantum strong-field limit, when only the lowest Landau state is populated, for both the degenerate and nondegenerate cases. Nonlocal shifts of local bulk plasma modes were evaluated for low wave number, and purely nonlocal modes are exhibited for both parallel and perpendicular propagation (including Bernstein resonances). Cyclotron resonance was also investigated, particularly in connection with the statistical transition from degeneracy to nondegeneracy that can be induced at high magnetic field strengths in the quantum strong-field limit. (Diss. Abstr. Int., B)

25423 TOROIDAL EQUILIBRIUM OF SCREW BELT PINCH. Kim, S. H. (Hang Yang Univ., Seoul). J. Korean Nucl. Soc.; 6: No. 4, 249-252(Dec 1974).

The equilibrium configuration of the screw belt pinch is obtained as the first-order correction on that of the straight pinch of infinite length. (auth)

25424 LOW PRESSURE DISCHARGE WITH HIGH-ENERGY ELECTRONS. Demirkhanov, R.A.; Kursanov, Y.V.; Skripal', L.P. Sov. Phys.-Tech. Phys. 19: No. 7, 891-894 (Jan 1975).

The potential distribution current and ion energy are found in a plasma with a non-Maxwellian electron distribution. If the density of high-energy electrons is above a critical value, the potential and ion energy at the boundary of the plasma are of the same order as the electron energy. Depending on the form of the electron distribution, the potential is either continuous or undergoes a jump across a space-charge double layer. (auth)

25425 CALCULATION OF FREE-FREE RADIATION FROM PLASMAS WITH NON-MAXWELLIAN ISOTROPIC OR ANISOTROPIC ELECTRON VELOCITY DISTRIBUTION. Eidmann, K. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 17: No. 2, 121-132(Feb 1975).

Calculations of the bremsstrahlung resulting from electron ion collisions in plasmas with non-Maxwellian electron velocity distributions are made with special regard to laser-produced plasmas. The quantum mechanical theory was used with restriction to nonrelativistic electron energies and a pure Coulomb potential of the ions within the plasma. Results for the spectrum, the angular dependence, the intensity and the polarization of the emitted bremsstrahlung for some examples of non-Maxwellian isotropic and anisotropic electron velocity distributions are presented. (auth)

25426 SELF-CONSISTENT VLASOV EQUILIBRIA FOR INTENSE HOLLOW RELATIVISTIC ELECTRON BEAMS. Davidson, R. C. (Univ. of Maryland, College Park); Striffler, C. D. J. Plasma Phys.; 12: 353-364(Dec 1974).

A procedure is discussed for constructing intense hollow relativistic electron beam equilibria within the framework of the steady-state ($\partial/\partial t = 0$) Vlasov-Maxwell equations. It is assumed that the electron beam propagates parallel to a uniform axial guide field $B_0^{ext} = B_0 e_z$ inside a grounded cylindrical conductor, and that the positive ions provide a partially neutralizing background with density $n_i^0(r) = f n_e^0(r)$, where f = const. = fractional neutralization. The equilibrium properties are calculated for the specific choice of electron distribution function $f_b^0(H, P_\theta, P_z) = n_0 R_0 (2\pi m_e \gamma_b^2 \gamma_0)^{-1} \delta(H - \beta_b c P_z - \gamma_0 m_e c^2/\gamma_b) \delta(P_\theta - P_0)$, where H, P_θ, and P_z are the energy, canonical angular momentum, and axial canonical momentum, respectively, for an electron moving in the equilibrium fields, and $n_0, R_0, \beta_b, \gamma_0, \gamma_b = (1 - \beta_b^2)^{-1/2}$, and P_0 are constants. For this choice of distribution function, the mean axial velocity of the electron beam is equal to $\beta_b c$ = const., and the beam density profile $n_b^0(r)$ is hollow with inner and outer radii, R_0 and R_1, determined self-consistently from nonlinear boundary conditions that involve the equilibrium parameters P_0, γ_b, γ_0, etc., and the equilibrium self fields. Closed expressions for R_0 and R_1 are obtained for the case where the collisionless skin depth c/ω_{pe} is large in comparison with the characteristic radius of the electron beam, and the beam density is sufficiently low that $(\omega_{pe}^2/\Omega_e^2) \mid \beta_b^2 - 1 + f \mid \ll 1$. The two cases, $P_0 > 0$ and $P_0 < 0$, are considered. (auth)

Plasma Production

Refer also to abstract 26932.

25427 PLASMA PRODUCTION BY BEAM-PLASMA DISCHARGE. Liu, H. Hoboken, NJ; Stevens Inst. of Tech. (1974). 97p. University Microfilms Order No. 75-2810.

Thesis (Ph. D.).

Plasma production by a beam-plasma discharge in magnetic field has been experimentally investigated. The collective interactions in density gradients play a crucial role in the production of plasmas. The beam plasma instability occurring in the axial density gradient of a beam produced plasma is measured. Under the proper conditions the waves, with $\omega < \omega_c$, will grow and decay completely in the inhomogeneous region. The decay is found to result from decoupling of the wave from the beam by an increasing phase velocity thus permitting Landau damping of the wave by the beam. The spatial evolution of beam thermalization along the discharge has been measured. At beam to plasma density ratio smaller than 10^{-2} plasma production is dominated by the plasma electrons which are heated by rf fields resulting from beam-plasma interaction. The rate of particle production has been calculated from the measured electron distribution and it was found to be equal to the measured loss rate along the field lines. The power balance of the beam-plasma interaction has been studied. About 30 to 65 percent of the beam power goes into the plasma. This is found to be equal to the power needed for ionization, electron heating and ion acceleration through plasma sheath. A quiescent, steady-state plasma in an axial magnetic field with density fluctuations less than 0.1% may be produced. The dependence of the density and electron temperature on the discharge parameters is in accordance with the prediction of a one-dimensional plasma generation model. (Diss. Abstr. Int., B)

25428 DT FUSION WITH MICROSHELLS. Brysk, H.: Hammerling, P. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). Phys. Rev. Lett. 34: No. 8, 502-503 (24 Feb 1975).

Henderson's calculations of thermonuclear-fusion neutrons from the implosion of DT-gas-filled glass microshells agree with experimental results at KMS Fusion, Inc. This indicates that important aspects of the physical description are properly understood, and helps to confirm that the observed neutrons are "true thermonuclear neutrons". (auth)

25429 AEROSOL-INDUCED AIR BREAKDOWN WITH CO_2 LASER RADIATION. Smith, D.C.; Brown, R.T. (United Aircraft Corporation, East Hartford, Connecticut 06108). J. Appl. Phys. 46: No. 3, 1146-1154 (Mar 1975).

The breakdown threshold with 10.6-μ wavelength CO_2 laser radiation induced by particles is reported. Single solid particles of different materials and sizes were suspended electrodynamically at the focus of a pulsed TEA laser and the thresholds for vaporization and also for particle-induced breakdown were measured. The threshold intensity for breakdown is of the order 10^8 W/cm^2, independent of particle size and material and represents the limiting intensity that can be propagated through an aerosol-laden atmosphere. (auth)

25430 ATOMIC PHYSICS ENCOUNTERS THE LASER. Burgess, D. D. (Imperial Coll. of Science and Tech., London). Phys. Bull. (London); 25: 573-574(Dec 1974).

Some areas of recent advances in atomic and molecular physics research are considered, with special reference to those in which plasma physics, astrophysics and the use of laser techniques have made a great impact. It seems inevitable that the impact of lasers on atomic physics will not only be an extension of the range and precision of "fundamental atomic data" but a revision of ideas about what constitutes data in the first place, and of the underlying theoretical language of the subject. Among recent work considered is that on atomic structure including investigation of energetic excitation of complex many-electron atoms. Laser based techniques have entered direct atomic structure observations in the form of detailed and extensive work using so called selective excitation spectroscopy on bound states and continuum resonances in Ba, Ca and Mg. Work using atomic beams is beginning to be influenced by the availability of tunable lasers. Atomic physics using high temperature laboratory plasma sources has continued to be of importance, both fundamentally and in astrophysical application. In this area, fixed frequency lasers made an early mark by providing extremely precise methods of determining electron densities and temperatures. The recent use of laser techniques in the field of atomic physics using high temperature laboratory plasma sources both fundamentally and in astrophysical applications is considered. The use of high power lasers for plasma production is discussed. (UK)

Plasma Stability

25431 (AD-784967) INVESTIGATIONS ON PLASMA INSTABILITIES. Final Scientific Report, 1 January 1972-30 June 1974. Cap, F. (Innsbruck Univ. (Austria). Inst. fuer Theoretische Physik). 30 Jun 1974. Contract F44620-72-C-0016. 28p. (UNICP-FR-74; AFOSR-TR-74-1298). NTIS $3.25.

The research covers work in the following fields: nonlinear theory, plasma instabilities, including stabilization and saturation, experimental results in Q-machine and hollow cathodes, wave excitation and conversion, and stability criteria. (auth)

25432 (AD-787455) NUMERICAL SOLUTIONS OF THE THREE-DIMENSIONAL KINETIC EQUATION OF THE PARA-

METRIC DECAY INSTABILITY. Final Report, January 1973–1974. Letterio, J. D.; Godfrey, B. B. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jul 1974. 136p. (AFWL-TR-74-146). NTIS $5.75.

The three-dimensional time-dependent kinetic equations for the saturation of the weakly driven parametric decay instability are solved numerically. Two cases are considered: (1) nonlinear Landau damping only and (2) nonlinear Landau damping plus mode-coupling. For both, relative pump powers range from 1 to 20. In general, the mode-coupling terms act to enhance saturation energy somewhat at large angles, without significantly affecting the total saturation energy level or the time evolution prior to saturation. For a deuterium plasma, the anomalous resistivity rate (relative to the plasma collision frequency) is found to be approximately $3.2\ P^{1.35}$, with P the relative pump power. (auth)

25433 (CEA-CONF-2777) NONLINEAR COUPLING OF KINK MODES. Dagazian, R. Y.; Rutherford, P. H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1974. 4p. (CONF-741024-4). Dep. NTIS (US Sales Only) $4.00.

From 2nd international conference on plasma theory; Kiev, USSR (28 Oct 1974).

Using a cylindrical geometry model, MHD and resistive instabilities with azimuthal mode numbers $m \geq 2$ have been shown to be inadequate to explain the occurrence of the negative voltage spikes of the Tokamak discharge. The m = 1 internal kink mode is the only MHD mode which possesses the correct features for predicting the occurrence of a negative voltage spike and a major radius contraction of the plasma column. However, it fails to qualitatively explain the experimental observations. The presence of high m magnetic fluctuations before and sometimes even after the occurrence of the disruptive instability, along with the partial success of the internal kink, suggests that this instability is a nonlinear phenomenon involving the interaction of the m = 1 internal mode with the higher m fluctuations. The interaction of the internal mode with the m = 2 kink is analyzed. (auth)

25434 (JAERI-M-5703) FEEDBACK STABILIZATION OF THE HIGH M KINK MODE. Wakatani, M.; Azumi, M. (Japan Atomic Energy Research Inst., Tokyo). May 1974. 9p. Dep. NTIS (US Sales Only).

In the cylindrical tokamak plasma of uniform current, the dispersion relation for high m kink modes is derived in the presence of a feedback magnetic field. The conditions for stabilizing high m kink mode and the magnitude of feedback current in the helical windings are described. Two methods of feedback stabilization are studied. In one, the feedback current is derived proportional to the perturbed poloidal magnetic field, and in the other the feedback current is derived as a step function after the kink mode has grown to some extent. Both the methods may be available in tokamak experiments. (auth)

25435 WAVELENGTH OF THE ELECTROTHERMAL INSTABILITY. Palmgren, S. (Aktiebolaget Atomenergi, Studsvik, Sweden). Phys. Scr.; 9: No. 3, 184-188(Mar 1974).

Discharges perpendicular to external magnetic fields in alkali-seeded noble gases lead to the formation of a well-defined electron density wave-pattern above a certain critical magnetic field strength. A one-dimensional nonlinear treatment of the electron density fluctuation is formulated based upon electron heat conduction as dissipative mechanism. The condition for the existence of periodic solutions to the differential equation so obtained is derived to show correspondence with linear analysis. For not too large density fluctuations an analytic expression for the characteristic wavelengths is obtainable, while stronger inhomogeneities are treated numerically. Methods for determining the wave amplitude are discussed briefly. (auth)

25436 STREAM INSTABILITY OF TWO-COMPONENT PLASMA LAYER. Bogdanov, E. P.; Romanov, Yu. A. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 10, 1446-1454(1974). (In Russian).

The stream instability of a two-component finite-thickness plasma layer is investigated in the elementary theory and quasi-hydrodynamic approximations. The instability boundaries and increments of increasing waves are found. It is shown that in thin layers in the absence of thermal motion of plasma particles asymmetrical E-waves (normal plasmons) are more unstable. In the presence of thermal motion symmetrical E-waves (tangential plasmons) are more unstable. Both in the class of symmetrical and asymmetrical waves in thin layers the surface waves are more unstable. The stream instability is absent in very thin layers. (auth)

25437 STABILITY AND DECAY OF PLASMA BUNCHES IN EXTERNAL STATIONARY MAGNETIC FIELD. Temko, S. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 9, 1442-1448(Sep 1974). (In Russian).

Invariant in the Lyapunov sense, particle distributions are obtained for the electroneutral plasma bunch in an external stationary magnetic field. Sufficient evaluation of the lifetime of the plasma bunch is given. (auth)

25438 PLASMA INFLUENCE ON THE CHARACTER OF DOUBLE-BEAM INSTABILITY. Kotsarenko, N. Ya.; Sinkevich, E. L.; Fedorchenko, A. M. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 8, 1272-1277(Aug 1974). (In Russian).

The character of double-beam instability is analyzed as influenced by the plasma. It is shown that the absolute instability exists if $\omega_b > \omega_p$ and connective instability, if $\omega_b < 2\omega_p$ (ω_p and ω_b), the Langmuir frequences of the plasma and beam, respectively. (auth)

25439 EQUILIBRIUM AND STABILITY OF ROTATING HIGH-BETA PLASMAS. Lehnert, B. (Kungliga Tekniska Hoegskolam, Stockholm). Phys. Scr.; 9: No. 4, 229-236(Apr 1974).

The equilibrium and stability of a fully ionized, dense, rapidly rotating, magnetized plasma is analyzed in terms of a simple model: (1) An equivalent beta value β_C is defined, being related to the centrifugal force and the corresponding azimuthal plasma current, as well as the associated radial "expansion" of the frozen-in magnetic field lines. (2) A steady state plasma balance exists only at beta values below a certain maximum, being due to an equilibrium limit at $\beta_C = 2/3$ or to a stability limit at $\beta_C > 2/3$. (3) The stability limit is due to the onset of a "centrifugal expansion instability" being similar to the mirror mode, but with the centrifugal force replacing this perpendicular pressure as driving mechanism. (4) Plasma structures which are strongly elongated in the magnetic field direction depend critically on the beta limitation. Such structures exist both in cosmos and in the laboratory. (5) The theory gives a possible explanation of earlier experiments on voltage limitation with the devices FI and FIII, in terms of a velocity limitation of the former and a beta limitation of the latter. (auth)

25440 HALL-CURRENTS AND RAYLEIGH–TAYLOR INSTABILITY OF A ROTATING PLASMA. Ariel, P. D. (Malaviya Regional Engineering Coll., Jaipur, India). Indian J. Phys.; 48: No. 8, 703-711(Aug 1974).

The effect of rotation on the development of Rayleigh–Taylor instability of an infinitely conducting plasma in the presence of a vertical magnetic field was investigated, taking into account the Hall effect. The solution is shown to be characterized by a variational principle. A use was made of the existence of variational principle to obtain an approximate solution to the problem of a plasma having exponentially varying density in the vertical direction. It has been found that the rotation in conjunction with Hall-currents has considerable stabilizing influence on the system. (auth)

25441 PARAMETRICALLY EXCITED INSTABILITIES IN A MAGNETIZED ELECTRON PLASMA. Seshadri, S. R. (Univ. of Wisconsin, Madison). Can. J. Phys.; 52: No. 24, 2495-2505 (15 Dec 1974).

The excitation of waves propagating perpendicular to the magnetostatic field in a cold, uniform plasma by an externally imposed high frequency electric field was investigated. Orientations of the external electric field parallel to the magnetostatic field as well as perpendicular to the magnetostatic field but inclined at an angle to the propagation direction are considered. In the former case, the ordinary mode is parametrically coupled to the two branches of the extraordinary mode and in the latter case, there is coupling between the two branches of the extraordinary mode itself. This parametric coupling leads to instabilities of the interacting waves. The conditions necessary for the excitation of the parametric instabilities as well as the dependence of the maximum growth rate of the instability on the strength of the magnetostatic field are also examined. (auth)

25442 EFFECT OF HIGH-FREQUENCY FIELD ON THE CORKSCREW INSTABILITY OF PLASMA WITH CURRENT. Coldatenkov, T. R.; Sidorov, V. P. Dokl. Akad. Nauk SSSR; 215: No. 2, 321-324(11 Mar 1974). (In Russian).

The stability of a plasma with free boundaries during projection through the plasma of a current with constant and high-frequency components was studied. (JSR)

25443 MEASUREMENT OF ION–ACOUSTIC PLASMA TURBULENCE BY CROSS–POWER SPECTRA. Ilić, D. B. (Institute for Plasma Research, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 34: No. 8, 464-466 (24 Feb 1975).

The propagation of current–driven ion–acoustic waves in a positive column is studied by measuring the cross–power spectral density up to

30 MHz. Dispersion characteristics are verified in the weakly turbulent state, and the measurments of instability correlation times and lengths are illustrated for higher levels of turbulence, where the dispersion relation no longer applies. (auth)

25444 PROPAGATION AND STABILITY OF LARGE AMPLITUDE IONIZATION WAVES. Gorelik, M.S.; Tsendin, L.D. (M. I. Kalinin Leningrad Polytechnic Institute). Sov. Phys.—Tech. Phys. 19: No. 7, 880-882 (Jan 1975).

Nonlinear ionization waves are investigated in a weakly ionized plasma which carries a current. Stationary and nonstationary waves with parameters which vary slowly in space and time are considered for various cases with weak dissipation. The stability regions for self—modulation and the propagation velocities of amplitude and frequency perturbations are found. The influence of dissipative effects on stability is considered. (auth)

25445 ION—ACOUSTIC INSTABILITY OF A FULLY IONIZED ULTRARELATIVISTIC PLASMA IN AN ELECTRIC FIELD. Dzhavakhishvili, D.I. (Tbilisi State University). Sov. Phys.—Tech. Phys. 19: No. 7, 959-960 (Jan 1975).

The stability of an ion—acoustic wave propagating in a collision—dominated, fully ionized hot—electron plasma is considered; the electron thermal energy considerably exceeds the electron rest energy. The growth rate is compared with the corresponding expression in nonrelativistic theory. It is shown that the growth rate is much smaller in a plasma with ultrarelativistic electrons. (auth)

25446 LOW FREQUENCY STABILITY THEORY OF AXISYMMETRIC TOROIDAL PLASMAS. Connor, J. W.; Hastie, R. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 17: No. 2, 109-120(Feb 1975).

The shear required to stabilize the electrostatic flute instability is calculated for a general low β, axisymmetric, toroidal magnetic field geometry. It is found that previous calculations underestimated the necessary shear. New destablizing effects, which are associated with the geodesic curvature, occur for flute modes with frequencies in the intermediate range (i.e., between electron and ion bounce frequencies). (auth)

25447 LOW FREQUENCY STABILITY THEORY OF AXISYMMETRIC TOROIDAL PLASMAS. I. General Theory. Connor, J. W.; Hastie, R. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 17: No. 2, 97-107(Feb 1975).

A formalism for discussing low frequency electrostatic modes in a general axisymmetric toroidal geometry is developed. Particular emphasis is laid on the conflict between the requirements of long parallel wavelengths and double toroidal periodicity in the presence of shear. Expressions for the perturbed charge density, useful for examining flute, drift, and trapped particle modes are presented. (auth)

25448 RESISTIVE TEARING MODES IN A SHEET PINCH WITH SHEAR FLOW. Hofmann, I. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 17: No. 2, 143-157(Feb 1975).

Resistive tearing modes are analyzed in a plane sheet pinch with shear bulk plasma flow present. A perturbation theory using asymptotic series is applied for small resistivity and zero viscosity. The analyticity problems arising in the vicinity of singular points are taken into account. For a suitably defined solution uniform convergence is proved and the scaling law for the growth rate derived. The instability region is shown to depend on the function fluid kinetic energy/magnetic field energy, where both stabilization and destabilization are possible effects of the shear flow. The relationship to the Kelvin-Helmholtz instability is discussed. (auth)

25449 ION-ACOUSTIC INSTABILITY OF THE POSITIVE COLUMN. Ilic, D. B.; Wheeler, G. M.; Crawford, P. W.; Self, S. A. (Stanford Univ., CA). J. Plasma Phys.; 12: 433-444(Dec 1974.

The excitation characteristics of the current-driven ion acoustic instability were studied, using a linearized kinetic model for a weakly ionized, unmagnetized plasma. Convective instability is predicted for typical low-pressure positive column conditions. The calculated spatial growth rates show a variation with frequency, which is similar to that of the amplitude variation with frequency of the self-excited instability measured in our positive column experiments in helium and argon. The comparison between theory and experiment indicates that ion Landau damping is significant for typical experimental conditions. (auth)

25450 TWO-STREAM INSTABILITY IN PLASMAS FOR ARBITRARY PROPAGATION. Aggarwal, S. S.; Talwar, S. P. (Univ. of Delhi). J. Plasma Phys.; 12: 395-403(Dec 1974).

The problem of the two-stream instability in warm, collisionless, field-free plasmas is investigated for arbitrary direction of propagation vector, using the moment equations. It is found that the configurations characterized by (1) a beam of electrons with ions immobile, and (2) all electrons moving through mobile ions, are stable for subsonic interpenetration speeds. For supersonic speeds, however, the configurations are unstable both for electrostatic and electromagnetic perturbations. The former instability is restricted only to a cone of propagation about the streaming direction, while the latter exists for all angles, and has growth rates that are even larger than the electrostatic growth rates in the limit of long-wavelength perturbations. (auth)

Thermonuclear Engineering and Equipment

25451 (AD-785401) EFFECTS OF HIGH POWER LASERS. Number 3. Report for January—March 1974. Hibben, S. G. (Informatics, Inc., Rockville, Md. (USA)). 7 Jun 1974. Contract F44620-72-C-0053. 65p. (AFOSR-TR-74-1440). NTIS $3.75.

A compilation of abstracts of Soviet studies on high-power laser technology that were published in the first quarter of 1974 is presented. Material on this subject for the previous year has appeared in the monthly selected material from Soviet technical literature for 1973, now discontinued. Articles were selected as the most pertinent from the total list of attached bibliographic entries. They are grouped by laser interaction with metals, dielectrics, semiconductors, miscellaneous targets, and laser-plasma interaction. A first-author index and an index of source abbreviations are appended. (auth)

25452 (CEA-CONF-2784) D^+ ION SOURCE FOR THE PRODUCTION OF NEGATIVE D^- IONS. Geller, R.; Jacquot, C.; Sermet, P. (Grenoble-1 Univ., 38 (France)). 1974. 5p. (CONF-741019-13). Dep. NTIS (US Sales Only) $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

One of the propositions for making an intense (10 MW at 1 MeV) beam of neutral D^0 atoms requires a flux of D^- ions of 12 mA/cm^2 over a large area. These D^- ions can be created from D^+ ions by charge exchange in a cesium target. We have constructed a source of D^+ ions that is both efficient (40% ionization of input gas) and of high quality (60 mA/cm^2 at 1.5 keV). A plasma having a density of 10^{12} cm^{-3} is created in a magnetic mirror field by rf heating at the electron cyclotron frequency (PRF = 300 W—f RF = 10 GHz) in a background pressure of $\sim 10^{-4}$ torr. Extraction electrodes spaced ~0.7 mm apart permit the extraction of 6 mA of D^+ through a 2.4 mm diameter hole or 1.2 mA of D^+ through a 1 mm by 1 mm slit. (auth)

25453 (COO-2234-4) PELLETS FOR FUSION REACTOR REFUELING. Technical Progress Report. (Illinois Univ., Urbana (USA)). 1975. Contract AT(11-1)-2234. 28p. Dep. NTIS $4.50.

The feasibility of refueling fusion reactors using solid pellets of deuterium—tritium is examined. A device was built which will allow studies to be made of the interaction between solid hydrogen pellets and a plasma. Gaseous hydrogen is liquified in a series of heat exchangers using liquid helium as the coolant. The refueling procedure is outlined. (MOW)

25454 (IPPJ-DT-39) MANUFACTURE OF HELICAL COILS (l = 2 AND l = 3). Fujiwaka, S.; Nagahori, H.; Imura, Y.; Fujiwara, M.; Miyamoto, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1973. 62p. (In Japanese). Dep. NTIS (US Sales Only).

Stellarator magnetic field was produced with two helical coils of l = 2 and l = 3, in order to study the effects of shear and rotary changing angle on plasma confinement and to study whether convection loss can be reduced by the stellarator magnetic field. This helical coil has an l = 3 coil outside a discharge tube, and over that coil, an l = 2 coil was wound. The toroidal coil is composed of 24 pancakes, and the diameter of the torus is one meter. The bobbin for the helical coil was manufactured with a grooving machine. The material for the bobbin requires the least secular change of dimensions incombustible, insulator and the strength to endure magnetic force by the helical coils. The material of the bobbin employed for these helical coils was epoxy-resin with 30% glass fiber. The amount of the glass fiber was decreased to improve cutting performance and to reduce hygroscopic property. The epoxy resin was employed in order to improve the strength against magnetic power. The coil is a water cooled hollow conductor because of high current density. (JA)

25455 (ORNL-TM-4602, pp 243-258) CONTROLLED THERMONUCLEAR PROCESSING. Dec 1974.

In experimental engineering section semiannual progress report (excluding reactor programs) September 1, 1973–February 28, 1974.

Tritium containment and plasma exhaust, processing for controlled thermonuclear reactors and the next-generation fusion experiment (i.e., ORMAK-F/BX program) were discussed. Plasma exhaust processing modules have been partially designed and preliminary cost estimates were made. Future plans include bench-scale system component testing and periodic design reviews. (auth)

25456 LASER INDUCED FUSION AND MICRO-FISSION EXPLOSIONS. Leuthaeuser, K. D. (Institut fuer Naturwissenschaftlich-Technische Trendanalysen (INT), Stohl (F. R. Germany)). Atomkernenergie; 24: No. 3, 193-195(1974). (In German).

In order to increase the effectiveness of laser-induced fusion in DT-pellets fission triggers consisting of Pu 239 microspheres of more than hundred times normal density had been proposed by F. Winterberg. The dynamic behavior of such super-dense fission configurations is estimated (characteristic times for hydrodynamic expansion by implosion pressure and fission-energy release, initiation of the chain reaction, and ignition probabilities), and the considerable physical problems are briefly discussed. (auth)

25457 METHOD AND DEVICE FOR OBTAINING CONTROLLED NUCLEAR FUSION BY MEANS OF ARTIFICIAL PLASMA. Nowak, K. US Patent 3,859,164. 7 Jan 1975. Priority date 21 May 1970, Austria. 6p.

For obtaining controlled nuclear fusion, two plasma beams of high density will be formed by blending of previously and separately accelerated atomic ion beams and electrons via deflection magnets, directed against each other with short impulses and combined to a fusion plasma within a reaction space surrounded by a contraction coil. With the axially aligned particle beams a high plasma density of 10^{22} to 10^{24} ions/ccm can be obtained and thus a good efficiency of fusion. (Official Gazette)

25458 NUCLEAR FUSION: THE NEXT BIG STEP WILL BE A TOKAMAK. Metz, W. D. Science; 187: No. 4175, 421-423 (7 Feb 1975).

The Princeton Two-Component Tokamak (TCT) is briefly described. Recent developments in neutral atom beam injection are pointed out. The effect of impurities on plasma heating is mentioned. (MOW)

25459 TORUS WINDINGS HAVING ASYMMETRIC MAGNET COILS. Luton, J. N. Jr.; Gauster, W. F.; Brown, R. L. (to Energy Research and Development Administration). US Patent 3,859,615. 7 Jan 1975. Filed date 30 Jul 1973. 4p.

For toroidal devices, magnet coils are provided that are not axisymmetrical about their central axes. The coils have a winding cross section which, on the side nearest the torus axis, is compact and carries a higher current density, while its opposite side is expanded and carries a lower current density. The new coil designs provide coil shapes that permit construction of the individual magnet coils with an appreciable reduction of power while permitting adequate access between the coils of the torus. (Official Gazette)

25460 STABILIZATION OF THE MAJOR RADIUS OF TOROIDAL PINCH BY A FEEDBACK SYSTEM. Arsenin, V.V. Sov. Phys.–Tech. Phys. 19: No. 7, 895-897 (Jan 1975).

The stabilization of the major radius of a toroidal current–carrying pinch by a feedback system is considered. The case in which the control field is homogeneous over the torus has been studied earlier. In the present work the more general case of an inhomogeneous winding density is considered. In particular, the winding can be local. A dispersion equation of the oscillations is obtained taking account of the mode coupling resulting from the breakdown of axial symmetry. When the frequency (growth rate) of oscillations of the major radius in the absence of stabilization is much less than the frequencies of the helical modes the coupling is weak. In the stable state the control field appears in the form of an average taken over a circuit around the torus. (auth)

25461 REFLECTION OF IONIZED HYDROGEN CLUSTERS AT POLISHED STAINLESS STEEL. Gspann, J.; Krieg, G. (Karlsruhe Kernverfahrenstechnik; Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Kernverfahrenstechnik). Z. Naturforsch., a; 29: No. 10, 1501-1503(Oct 1974).

Ionized hydrogen clusters of either charge polarity containing some 10^3 molecules of hydrogen can be reflected at a polished stainless steel surface, for purposes of fusion fuel injection, very similarly to neutral clusters. The effective charge of positive cluster ions increases by a factor of about 1.5 during the reflection. (auth)

25462 NUCLEAR POWER PLANTS WITH FUSION REACTOR. Kalide, W. pp 143-148 of Power Plants and Power Economy. Kalide, W. Muenchen, F. R. Germany; Hanser (1974). (In German).

A brief, generally understandable chapter on the gaining of energy by nuclear fusion is given. Following the important fusion reactions, the problems of the plasma confinement and heating are mentioned. Furthermore, general construction features of a future fusion reactor as well as a circuit diagram of a fusion power plant are given. (GE)

Wave Phenomena

Refer also to abstracts 25443–25445.

25463 (AD-786534) ANALYSIS OF WAVE–PARTICLE INTERACTIONS IN A BEAM PLASMA SYSTEM. Winske, D. (Illinois Univ., Urbana (USA). Coordinated Science Lab.). Jul 1974. Contract DAAB07-72-C-0259. 197p. (R–652; UILU-ENG-74-2218). NTIS $7.00.

Several mechanisms to explain the saturation of the beam plasma instability and the simultaneous broadening of the beam energy distribution function for the case where the beam is cold and weak and the plasma is cold and collision dominated are explored. (auth)

25464 (IPPJ-186) COUPLED NONLINEAR ELECTRON-PLASMA AND ION-ACOUSTIC WAVES. Nishikawa, K.; Hojo, H.; Mima, K.; Ikezi, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1974. 11p. Dep. NTIS (US Sales Only).

Solutions describing stationary one-dimensional propagation of coupled nonlinear electron plasma waves and nonlinear ion acoustic waves were obtained. They have the amplitudes linearly proportional to each other, and propagate with approximately the ion acoustic velocity in the form of periodic wave-trains, including solitary waves as special case. (auth)

25465 (LRP-88/74) GENERATION OF MONOCHROMATIC ELECTROSTATIC WAVES OF LARGE AMPLITUDES IN A BOUNDED BEAM–PLASMA SYSTEM. Bitter, M.; Paris, P. J. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Dec 1974. 34p. Dep. NTIS (US Sales Only) $4.75.

Monochromatic electrostatic waves with amplitudes of 20 to 60 db above the noise level were generated by the interaction of an electron beam with a bounded plasma. These waves were identified as resonant beam modes, which are amplified by multiple reflection within a cavity (cathode grid region of the discharge). The existence of a threshold for the excitation of the waves was proven experimentally by varying the beam velocity and the plasma density. Nonlinear effects as the generation of harmonics and sidebands were observed. The sidebands may be generated by two nonlinear processes. (auth)

25466 HIGH-FREQUENCY ELECTRIC FIELD EXTERNAL CONTROL ON THE PROPAGATION OF ION WAVES ON A SEMI-BOUNDED PLASMA. Zhelyazkov, I.; Nenovski, P. (Sofia Univ. (Bulgaria)). Phys. Lett., A; 50: No. 4, 289-290(11 Dec 1974).

The influence of a high-frequency electric field, driving a semi-bounded nonisothermal plasma, on the propagation of surface ion-acoustic waves with subthreshold values of the pump field is examined. (auth)

25467 PROPAGATION OF MAGNETOFLUID DYNAMIC WAVES IN AN INCOMPRESSIBLE PLASMA. Mattei, G. Ann. Mat. Pura Appl.; 94: 315-344(1972). (In Italian).

A homogeneous incompressible nondissipative plasma in the continuous scheme is considered. Plane linear and nonlinear magnetohydrodynamic waves with and without Hall effect were studied. Hall effect and simultaneous uniform rotation are also considered. The discontinuity surface was examined. (Appl. Mech. Rev.)

25468 DEEP SEPARATION OF CHARGES IN ELECTRON-BEAM PLASMA AND FORMATION OF HIGH-FREQUENCY DISCHARGE. Gabovich, M. D.; Gladkii, A. M.; Kovalenko, V. P. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 10, 1704-1707(Oct 1974). (In Russian).

The results of direct measurements for the magnitude of high-frequency electric fields of the plasma oscillations excited by the electron beam are presented. It was found that the amplitude of these oscillations may reach the values corresponding to almost complete separation of the plasma charges. A problem is under discussion on the additional ionization of gas by fields of the plasma oscillations. (auth)

25469 ECHO IN A NON-EQUILIBRIUM MAGNETOACTIVE PLASMA. Pavlenko, V. N.; Revenchuk, S. M. (Inst. of Geo-

physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 10, 1653-1661(Oct 1974). (In Russian).

The time and spatial echo of the second order was investigated in a homogeneous magnetoactive plasma penetrated by a beam of charged particles of low density. The echo oscillations due to nonlinear wave transformation in such a plasma are studied, particularly when the effect of two external transverse disturbances on the plasma produces a longitudinal echo and when the interaction of longitudinal and transverse waves yields a transverse echo. It is shown that when instability occurs the longitudinal and transverse echo oscillations can grow in space and be intensified in time. (auth)

25470 EXCITATION OF PLASMA ELECTRONIC OSCILLATIONS BY THE FAST BEAM OF NEGATIVE IONS. Simonenko, L. S.; Soloshenko, I. A.; Shkorina, N. V. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 11, 1886-1891(Nov 1974). (In Russian).

Collective interaction of the beam of negative ions with plasma created due to ionization of the residual gas by the beam is studied for the first time. The beam of negative ions, the velocity of which exceeds the electron thermal velocity, is established to excite plasma electronic oscillations. The linear stage of the interaction is investigated. The influence of radial limitation of the system on excitation of the mentioned oscillations is shown. (auth)

25471 CONTRIBUTION TO NONLINEAR FREQUENCY SHIFTS FROM DIFFUSION IN VELOCITY SPACE. Falk, L. (Chalmers Tekniska Hoegskola, Goteborg); Kocherga, O. D. Phys. Scr.; 9: No. 4, 237-240(Apr 1974).

The resonant interaction of four longitudinal plasma waves is investigated taking into account the influence of the waves on the background distribution function. This effect gives essential contribution to the nonlinear frequency shift. Langmuir waves in a cold plasma are considered as an example. (auth)

25472 ELECTROMAGNETIC FIELDS OUTSIDE A SYNTHESIZED PLASMA JET. Bogdanov, E.V.; Mantrova, G.M.; Yakovleva, M.N. (Institute of Radio Engineering and Electronics, Academy of Sciences of the USSR, Moscow). Sov. Phys.—Tech. Phys. 19: No. 7, 919-921 (Jan 1975).

An experimental study is made of the high—frequency oscillations of argon plasma in synthesized jet in the range 20—200 MHz at distances $r \leqslant \lambda$ from the axis of the jet. At distances $r/\lambda < 0.3$ the field from the jet is similar to the field in the near—field region of a dipole. The possibility of increasing the radiation from the jet by inserting a conductor in the jet or placing a dielectric plate across it is demonstrated experimentally. The coefficient for conversion of the longitudinal wave into an electromagnetic wave is estimated for the case of an immersed conductor—antenna. The increase in the radiation in the case of the dielectric plate is due mainly to an increase in the amplitude of the field of the high—frequency oscillations in the jet as the result of a reflected electron stream. (auth)

25473 EFFECT OF IONIZATION AND EXCITATION ON THE PENETRATION OF AN ELECTROMAGNETIC WAVE INTO A WEAKLY IONIZED PLASMA. Boev, A.G.; Prokopov, A.V. (Institute of Radiophysics and Electronics, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Tech. Phys. 19: No. 7, 901-904 (Jan 1975).

The effect of excitation and ionization on the spatial structure of a low—frequency electromagnetic field ($\omega < \nu$) in a plasma is analyzed. It is shown that consideration of these processes leads to a qualitatively different dependence of skin depth (a decrease rather than an increase) on the amplitude of the incident field as compared with the case in which only elastic processes are considered. Calculated results for the skin depth and the dependence on amplitude are given for a discharge in argon excited by an electromagnetic field with $\lambda = 10$ cm. (auth)

25474 SOLITARY WAVES IN ANISOTROPIC PLASMA WAVEGUIDE. Kurilko, V.I.; Tolstoluzhskii, A.P. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Tech. Phys. 19: No. 7, 887-890 (Jan 1975).

An analytical and numerical study is made of the field configuration and dispersion of solitary waves of finite amplitude propagating along the axis of a cylindrical plasma waveguide with conducting walls in a strong external magnetic field. Curves are given which show the potential distribution on the waveguide axis and the phase velocity of the solitary waves as a function of amplitude. Even when the amplitudes of the fields are comparable with the maximum permissible amplitude, when effects associated with the intersection of the trajectories of the plasma electrons become significant the main contribution to the field configuration and the dispersion comes from a single radial harmonic of the field. The dependence of the characteristics of a solitary wave on the linear density of the plasma is investigated. (auth)

25475 BREWSTER ANGLE FOR A PLASMA MEDIUM MOVING AT RELATIVISTIC SPEED. Kalluri, D.; Shrivastava, R.K. (Department of Electrical Engineering, Birla Institute of Technology, Mesra, Ranchi, India). J. Appl. Phys. 46: No. 3, 1408-1409 (Mar 1975).

The Brewster angle for parallel—polarized electromagnetic waves incident on a relativistically moving isotropic plasma half—space is investigated. There exist two Brewster angles for certain ranges of the medium velocity irrespective of whether the medium moves parallel or normal to the interface. In the case of parallel motion, it is found that there are no Brewster angles for wave frequencies less than the plasma frequency. (auth)

25476 NONLINEAR SURFACE—WAVE PROPAGATION OVER PLASMAS AND CONDUCTORS. Bhat, B.; Tripathi, V.K. (School of Radar Studies, Indian Institute of Technology, New Delhi—110029, India). J. Appl. Phys. 46: No. 3, 1141-1145 (Mar 1975).

An investigation of nonlinear surface—wave propagation over plasmas and conductors has been carried out when the nonlinearity in the complex dielectric constant arises on account of ponderomotive force and energy—dependent collisions. Analytical expressions have been obtained for the decay rate and phase velocity of the evanescent wave in the limit of perturbation approximation. The nonlinearity is found to reduce the rate of decay of an evanescent wave in a conductor and also in the case of a dense plasma. A study of the phenomenon of total internal reflection reveals that the critical angle increases due to nonlinearity and the evanescent wave decays slower. (auth)

25477 TOTAL REFLECTION OF A FREQUENCY MODULATED ELECTROMAGNETIC PULSE FROM A MOVING PLASMA. Gautama, G. D.; Rattan, I. (Indian Inst. of Tech., Delhi). Int. J. Electron.; 37: No. 5, 633-635(Nov 1974).

Reflection of a frequency modulated electromagnetic pulse from a moving homogeneous and lossless plasma half-space/plasma slab was investigated theoretically. Dependence of the reflected pulse on various moving plasma parameters and the modulation of the incident pulse are discussed. (auth)

25478 COMPARISON BETWEEN THEORY AND EXPERIMENTS ON NON-LINEAR THREE-WAVE INTERACTIONS IN PLASMA. Peng, Y. K. M. (Oak Ridge National Lab., TN). Int. J. Electron.; 37: No. 5, 667-688(Nov 1974).

Quantitative comparisons between theory and experiments on nonlinear three-wave interactions in a nearly homogeneous plasma are presented. First, the theoretical spatial behavior of signal and idler waves excited by a large amplitude pump wave is predicted, with damping of all waves included. These results are then specialized to allow detailed quantitative comparisons to be made with available experimental data on parametrically excited ion-acoustic waves. Where good agreement is obtained, the comparison indicates further measurements required to verify more completely the basic theory of three-wave interactions in plasmas. Where wide disagreement is obtained, the comparison indicates possible directions in which the theory might be improved. (auth)

25479 LANDAU DAMPING AND CYCLOTRON RESONANCE IN UNIFORM MAGNETOPLASMA. Vyas, N. K.; Das, A. C. (Physical Research Lab., Ahmedabad, India). Nature (London); 253: No. 5486, 29-30(3 Jan 1975).

A discussion is given on a homogeneous collisionless hot plasma in a uniform magnetic field. The electron plasma waves are Landau damped and expressions are derived for their growth rate and electron distributions, including the growth rate for whistler mode perturbations resulting from cyclotron resonance with electrons. (UK)

25480 EFFECTS OF THE PUMP SYMMETRY ON THE PARAMETRIC EXCITATION OF TRANSVERSE AND LONGITUDINAL WAVES. Hung, N. T. (Ecole Polytechnique Federale, Lausanne, Switzerland). Plasma Phys.; 17: No. 2, 159-163(Feb 1975).

The parametric coupling of transverse and longitudinal waves in a plasma is shown to depend strongly on the structure of the pump wave. Within the fluid model, the threshold pump intensity and the maximum growth rate of the excited waves are obtained for the cases of a linearly polarized, travelling, and a standing circularly polarized pump wave. (auth)

25481 PERIODIC FOCUSING OF A GAUSSIAN ELECTROMAGNETIC BEAM IN MAGNETO-PLASMA. Tewari, D. P.; Kumar, A. (Indian Inst. of Tech., Delhi). Plasma Phys.; 17: No. 2, 133-141(Feb 1975).

In the presence of an intense gaussian electromagnetic beam, the electrons in a magnetoplasma are heated nonuniformly and their subsequent redistribution gives rise to a saturating nonlinear dielectric constant. A rigorous kinetic treatment suggests that the plasma is always in quasithermal equilibrium. Nevertheless, the energy dependence of the relaxation time is a very sensitive parameter and has various interesting features. The

presence of a static magnetic field adds much more to the asymmetrical behavior of the two modes in the plasma. All these effects manifest themselves in the periodic focusing of the beam. (auth)

25482 SECOND HARMONIC GENERATION USING SPATIALLY VARYING STATIC ELECTRON NUMBER DENSITY IN A MAGNETOPLASMA. Chakrabarti, N. B. (Indian Inst. of Tech., Kharagpur); Basu, B. N. J. Plasma Phys.; 12: 405-415(Dec 1974).

The Boltzmann transfer equation for electrons in an rf discharge plasma immersed in a stationary magnetic field is solved for the various coefficients of the expansion of the distribution function, expanded in a Taylor series in velocity space. Assuming a spatial variation of static electron number density as the mechanism of harmonic generation, explicit expressions for the inner field and the second harmonic current density are derived. The rf electric field is assumed to be spatially uniform. The geometry of the plasma considered is that of a rectangular waveguide, but with the parallel plates of one of the two pairs of the metal plate boundaries of the plasma much more closely spaced than those of the other pair. Cyclotron resonance is studied in a situation where the frequency of electron-neutral particle collisions ν is much less than the frequency of the rf field $\omega/2\pi$. The resonance effect is obtained, and is found to be more pronounced at the cyclotron frequency $\omega = \omega_c$ than at $2\omega = \omega_c$. For $\nu \gg \omega/2\pi$, the result is not sensitive to the value of the stationary magnetic field, and the resonance effects are absent. The effect of collisions on the process of harmonic generation is also studied. (auth)

25483 PITCH ANGLE AND ENERGY DIFFUSION COEFFICIENTS FROM RESONANT INTERACTIONS WITH ION-CYCLOTRON AND WHISTLER WAVES. Lyons, L. R. (National Oceanic and Atmospheric Administration, Boulder, CO). J. Plasma Phys.; 12: 417-432(Dec 1974).

General relations for quasi-linear diffusion coefficients in pitch angle and energy are applied to resonant particle interactions with ion-cyclotron and whistler waves. Expressions for the diffusion coefficients, valid for any distribution of wave energy with frequency and wave normal angle, are derived and normalized to be independent of the ambient magnetic field intensity and the electron density. The results illustrate how resonant particle diffusion rates vary with pitch angle and energy, and how the diffusion rates depend upon the distribution of wave energy. (auth)

25484 APPLICATION OF THE THEORY OF MIXING SYSTEMS TO NONLINEAR LANDAU DAMPING. Kirlin, L. (Ceskoslovenska Akademie Ved, Prague). J. Plasma Phys.; 12: 365-379(Dec 1974).

Using a simple model of particles in a discrete spectrum of waves, the influence of stochastic instability of particle motion on the mechanism of nonlinear Landau damping was investigated. It is shown that, as long as particle trajectories in the spectrum are stochastically unstable (at the beat resonances under consideration), diffusion of particles takes place. The influence of this effect on the normal nonlinear Landau mechanism is discussed, and the possibility of consequent heating in beam–plasma experiments is considered. (auth)

25485 ENERGY TRANSFER EQUATION AND UNIVERSAL SPECTRUM OF ION-ACOUSTIC WAVE TURBULENCE. Tajima, T. (Tokyo Univ.); Ichimaru, S.; Nakano, T. J. Plasma Phys.; 12: 381-393(Dec 1974).

The energy transfer equation in wavenumber space of ion-acoustic wave turbulence is obtained through investigation of the effects of turbulent fluctuations on the propagator of a test wave in the plasma. Those turbulent fluctuations whose wavelengths are shorter than that of the test wave give rise to collisional effects, while those with longer wavelengths act to deform continuously the shape of the test wave, thereby producing a diffusive flow of the turbulence energy in k space. Dimensional analysis, coupled with the Holmogorov hypothesis, is then carried out on the resulting equation; a universal spectrum proportional to $k^{-\frac{1}{2}}$ in the large k subdivision and to k^{-4} in the small k subdivision of the inertial domain is thus obtained. (auth)

ENGINEERING

Energy Conversion

25486 (AD-787496) RADIOISOTOPE POWER GENERATOR (RPG) SENTINEL 25F SHOCK AND VIBRATION STUDIES. Final Report. Rzepka, E. M. (Naval Ordnance Lab., White Oak, Md. (USA)). 7 Aug 1974. 79p. (NOLTR-74-148). NTIS $4.75.

An investigation was conducted to determine the ruggedness and performance of a commercially designed radioisotope power generator, Sentinel 25, under varying conditions of shock and vibration. A test program was designed incorporating the basic design conditions of MIL-STD-810B for shock and vibration. The program was conducted on an operating RPG. Althouth the RPG failed to meet the basic design requirements of MIL-STD-810B, the results of the shock and vibration program do indicate that the RPG is sufficiently rugged for normal truck, air, or ship transportation. However, during any type of handling which would expose the RPG to a shock of 30G with a velocity change of 5.3 fps or a drop of 9 in. or greater on earth and hard surfaces, performance would most likely be degraded. (auth)

25487 (N-74-28106) POWER CONDITIONING SYSTEM FOR RADIOISOTOPE THERMOELECTRIC GENERATOR ENERGY SOURCES. Gillis, J. A. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jun 1974. 27p. (NASA-TM-X-70678; X-711-74-164). NTIS $4.50.

The use of radioisotope thermoelectric generators (RTG) as the primary source of energy in unmanned spacecraft is discussed. RTG output control, power conditioning system requirements, the electrical design, and circuit performance are also discussed. (STAR)

25488 (N-74-28723) PERFORMANCE OF THE ELECTRICAL CONTROLS FOR THE MINI-BRAYTON SYSTEM. Birchenough, A. G. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jul 1974. 14p. (NASA-TM-X-3084; E-7921). NTIS $3.00.

The design theory and performance of a breadboard of the proposed mini-Brayton electrical control system is presented. The mini-Brayton is a nuclear isotope powered dynamic power conversion system. Testing was performed with an electronic simulation of a turbine alternator. Data on the voltage regulation, speed control, power consumption, reliability and transient response are presented for the breadboard. (auth)

25489 (N-74-30338) THERMAL STRESS FAILURE OF THE SNAP-19A RTG HEAT SHIELD. Pitts, W. C.; Anderson, L. A. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). Jul 1974. 12p. (NASA-TM-X-3097). NTIS $3.00.

Results of a study on thermal stress problems in an amorphous graphite heat shield that is part of the launch-abort protect system for the SNAP-19A radioisotope thermoelectric generators (RTG) that will be used on the Viking Mars Lander are presented. The first result is from a thermal stress analysis of a full-scale RTG heat source that failed to survive a suborbital entry flight test, possibly due to thermal stress failure. It was calculated that the maximum stress in the heat shield was only 50 percent of the ultimate strength of the material. To provide information on the stress failure criterion used for this calculation, some heat shield specimens were fractured under abort entry conditions in a plasma arc facility. It was found that in regions free of stress concentrations the POCO graphite heat shield material did fracture when the local stress reached the ultimate uniaxial stress of the material. (auth)

25490 MAGNETOHYDRODYNAMIC CHANNEL FLOW IN A TAPERED MAGNETIC FIELD. Regirer, S.A. (Institute of Mechanics, M. V. Lomonosov Moscow State University). Sov. Phys.-Tech. Phys. 19: No. 7, 874-877 (Jan 1975).

Fully developed flows of a viscous incompressible isotropically conducting fluid are investigated in a rectangular channel in the presence of a transverse magnetic field $B = (B_0/a)(-e_x y + e_y z)$. An exact solution of the problem is obtained in general form and for the limiting case corresponding to a flow in a plane slit. It is shown that at high Hartmann numbers a region of elevated velocities can form near the axis of the channel. In this regard, a flow in a plane slit exhibits a paradox: The reason is that the limiting case "carries" the region with an infinitely large emf to infinity; in the region considered the flow acts as a pump. In conclusion, some other flows in inhomogeneous fields with tapered geometry are considered. (auth)

Facilities and Equipment

Refer also to abstracts 25935, 26228, 27938, 27939, 28513, and 28606.

25491 (AGC-2357(Vol.1)) NUCLEAR ROCKET DEVELOPMENT STATION, JACKASS FLATS, NEVADA. Volume I. Engine Test Stand No. 2., Phase I. (Aerojet-General Corp., Sacramento, Calif. (USA)). 2 Aug 1962. 254p. Dep. NTIS $15.75.

Volume 1 of a 3-volume report consists of the engineering analysis, summarization of studies and establishment of the Facilities Design Requirements for Engine Test Stand No. 2 (ETS-2). ETS-2 is essentially an addition to the ETS-1 complex. It is to be designed and constructed to provide additional development and test capabilities required for the downward attitude test firing of NERVA and Phoebus class engines. (TFD)

25492 (AGC-2585) EVALUATION AND COMPARISON OF ATTITUDE CONTROL SYSTEMS FOR SPACECRAFT WITH NERVA ENGINES. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1963. 11p. Dep. NTIS $4.00.

25493 (AGC-2700) ETS-1 NES DUCT FACILITY SUBSCALE SEAL TEST PROGRAM. (Aerojet-General Corp., Azusa, Calif. (USA)). Oct 1963. 44p. Dep. NTIS $5.25.

A ¼ scale seal test program was conducted to evaluate three types of metallic seals and to determine the types that are best suited for use in the design of the ETS-1 NES duct. Results indicated that a double, aluminum, "Conoseal" backed by an inert gas buffer zone will provide satisfactory sealing and safety for the NES duct operation. However, the test indicated that the present Conoseal design was unsuitable for repeated use. (auth)

25494 (AGC-52449) DEVELOPMENT TEST TO OBTAIN STRESS AND DEFLECTION DATA ON STEEL AND ALUMINUM FLANGE ASSEMBLIES. (Wyle Labs., El Segundo, Calif. (USA)). 30 Apr 1971. 66p. Dep. NTIS $6.50.

For Aerojet Nuclear Systems Co., Sacramento, CA.

One steel and one aluminum flange assembly were subjected to development tests. Limiting stress values were obtained under various load and pressure conditions and are tabulated. (DLC)

25495 (ANS-9026) SEALS: ASSEMBLY AND HANDLING OF. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 10 Mar 1964. 7p. Dep. NTIS $4.00.

Handling and assembly requirements for metallic and non-metallic seals designed for use between the mating surfaces of fluid-carrying components to preclude the loss of fluids from between these surfaces are given. (TFD)

25496 (KFK-2093) MULTIPURPOSE SODIUM TEST LOOP ML-1 AT THE MADRID NUCLEAR ENERGY CENTER. Bojarsky, E.; Oltra Oltra, F.; Leising, H. A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Dec 1974. 24p. (In German). Dep. NTIS (US Sales Only) $4.25.

In 1973 a multi-purpose sodium test facility was commissioned on the site of the Spanish Nuclear Energy Center of Madrid, which had been built within the framework of German-Spanish cooperation on the peaceful uses of nuclear energy. A survey is presented of the layout of this up-to-date facility with its multiple means of experimentation and the various safety precautions are also described. In addition to a basic or purification loop with a 5 m^3 sodium dumping tank, a cold trap, a plugging meter, etc., a main loop and a corrosion loop have been provided which can be run separately from each other. While the main loop serves to supply several different test sections, the corrosion loop has been designed as a complete component containing specimen recipients in the sodium flow with rising and reducing temperatures (max. 730°C), a cold trap of its own, a hot trap, an electrochemical O_2-measurement probe, a sodium sampling station, and a plugging meter. (auth)

25497 (LA-5769) CAVITY STABILITY: FINITE ELEMENT ANALYSIS FOR STEADY AND TRANSIENT CREEP. Anderson, C. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1974. Contract W-7405-eng-36. 20p. Dep. NTIS $4.00.

Long-term steady-state creep and creep rupture of underground structures is a problem of increasing importance by virtue of the implications to storage of radioactive waste materials and to energy extraction methods which employ underground structures or cavities. The axisymmetric finite element code CSAAS which has

been developed at the Los Alamos Scientific Laboratory in order to look at these problems is described. Special attention is directed to the "nearly incompressible" element formulation in CSAAS and to the stable method of time stepping which is used to obtain an estimate of the incompressible steady creep state from an initial elastic solution. Applications are made to thermal creep problems involving pure halite which obeys a well documented creep law of Weertman's form; the flow rule for axisymmetric stress states is based on the Prandtl-Reuss law of metal plasticity. The remaining discretized equations are highly nonlinear. Comparison of the numerical results from CSAAS with the few known analytical solutions to one-dimensional steady creep problems indicates a high degree of accuracy for this finite element method. When the code is applied to the examination of the long-term stability of a spherical cavity in halite, various steady motions of the cavity (such as buoyancy or slumping) can be observed, depending on the depth, the temperature field, and the internal pressurization of the cavity. (auth)

25498 (NRO-671861(Folder 1)) PROPOSAL FOR A TOOL, BOLT REMOVAL, SPACE TO GEORGE C. MARSHALL SPACE FLIGHT CENTER, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. Folder I. Technical Proposal and Program Plan. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 29p. Dep. NTIS $4.50.

This proposal covers the design, manufacture, proof testing, and delivery of one tool, bolt removal, space, prototype, for underwater development testing, and is designated Aerojet-General Corporation Part No. 1133860. (auth)

25499 (NTO-2657) NERVA TEST OPERATIONS AND SUPPORT SERVICES, CONTRACTOR RESPONSIBILITIES AT NRDS. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 5 Aug 1963. 36p. Dep. NTIS $5.00.

The specific tasks and responsibilities of the NERVA Test Operations Team and the Support Services Contractor for the performance of the NERVA Program at NRDS are set forth. This will provide a better understanding of the philosophy of operations envisioned by the Aerojet-General Corporation/Westinghouse Astronuclear Laboratory Team in performance of Contract SNP-1 and will establish interface agreements with the Support Service Contractor. (auth)

25500 (NTO-R-0086) ETS-1 FACILITY DATA BOOK. Preliminary Issue. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 2 Aug 1966. 300p. Dep. NTIS $18.00.

A single source reference of component and piping data for selected ETS-1 facility fluid systems is provided in order to aid in carrying out the responsibilities of the ETS-1 Operations Analysis Group. The fluid systems described include: the gas storage system; the GN_2 supply system; the GHe supply system; the GH_2 supply system; the LH_2 storage and transfer system; the high pressure LH_2 storage and transfer system; the LH_2 run tank and propellant feed system; the LN_2 storage and supply system; and the main engine supply lines interface system. (auth)

25501 (NTO-R-0165) COMPUTATIONS AND DATA CHANNELS IN THE COMPUTER DATA LINK BETWEEN THE ETS-1 INSTRUMENTATION SYSTEM AND THE ETS-1 TEST DIAGNOSTIC CENTER. Cruddace, R. G. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 17 Jan 1969. 63p. Dep. NTIS $6.25.

Declassified 16 Jun 1970.

The ETS-1 Test Diagnostic Center (TDC) receives information through a microwave link from a CDC 3200 computer, which in turn receives data through a microwave link from the ETS-1 instrumentation system. The calculations made by the computer, the information transmitted to the TDC, and the instrumentation channels which are used by the computer programs are described. (auth)

25502 (ORNL-5007) PERSONNEL INVOLVED IN THE DEVELOPMENT OF NUCLEAR STANDARDS IN THE UNITED STATES, 1974. Zapp, F. C. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 381p. Dep. NTIS $10.60.

A new approach was taken in producing the 1974 Edition of the Personnel Directory. A computer data bank has been developed which will be a viable source of information to serve the overall nuclear standards community. The Directory is essentially an information source for identifying and locating personnel who have expertise in a particular nuclear area or subject, and the ORNL data bank can be utilized as a national information center for personnel involved in the development of voluntary consensus nuclear standards. The Directory contains the following indexes: personal name; company name; standards organizations and committees; and keyword-in-context (KWIC). (TFD)

25503 (ORNL-SUB-3651-2) REPORT ON TESTS OF TWO 4-INCH SCH. 10 ELBOW ASSEMBLIES. Griffith, W. I.; Rodabaugh, E. C. (Battelle Columbus Labs., Ohio (USA)). 1 Dec 1974. 96p. Dep. NTIS $8.00.

For Oak Ridge National Lab., TN.

Tests performed to determine the stress distributions and deformation of curved pipes at elevated temperatures are described. The results obtained on two annealed 304 stainless steel test assemblies using 4 in. Sch 10, 6 in. bend radius elbows are presented. One assembly was tested at 1100°F by applying a controlled in-plane displacement. The second was tested at 1100°F by applying weights to produce an in-plane moment loading. (LCL)

25504 (ORNL-TM-3795) STRESS INDICES AND FLEXIBILITY FACTORS FOR CONCENTRIC REDUCERS. Rodabaugh, E. C.; Moore, S. E. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 84p. Dep. NTIS $5.45.

Stress indices and the appropriate simplified design formulas are developed for analyzing piping reducers according to the philosophy of Section III of the ASME Boiler and Pressure Vessel Code for Class 1 piping systems. Relatively simple equations based on extensive analytical parameter studies and related experimental data from the literature are developed for the evaluation of primary-plus-secondary and peak stresses due to internal-pressure and bending-moment loads. These simple formulas may be used directly by designers and/or incorporated into the codes and standards. Indices for primary stresses are discussed, but additional information is needed before definitive recommendations can be made. The definition, applicability, and calculation of flexibility factors for reducers subjected to bending and torsional moments are also discussed. The flexibility of reducers is then compared with the flexibility for elbows. Specific recommendations are made for incorporating the stress-index equations, definitions, and limits into the ASME Code along with a method for calculating the flexibility contribution of reducers. (auth)

25505 (RAPO-7002(Rev.N)) PACKAGE AND SHIPPING PROCEDURE TO NRDS. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 30 Apr 1968. 15p. Dep. NTIS $4.00.

The method to be used in packaging the Reactor/Vessel Assembly for shipping to NRDS by flat car from the Assembly Bay is described. (auth)

25506 (RDT-E-8-18T(2-75)) THREADED FASTENERS FOR NUCLEAR COMPONENTS. (USERDA Division of Reactor Research and Development, Washington, D. C.). Feb 1975. 10p. RSO.

This standard covers threaded fasteners for use in nuclear and associated applications to be manufactured from specified bolting material furnished as forgings, rod, or bar stock. Threaded fasteners include bolts, studs, screws, and nuts, whose general use is for flange connections and closures in pressure systems. It supersedes the Oct. 1971 issue of RDT E 8-18T. (TFD)

25507 (RDT-M-6-4T(2-75)) ALLOY STEEL NUTS FOR BOLTING FOR HIGH-PRESSURE AND HIGH-TEMPERATURE SERVICE (ASME SA-194 WITH ADDITIONAL REQUIREMENTS). (USERDA Division of Reactor Research and Development, Washington, D. C.). Feb 1975. 8p. RSO.

This standard covers alloy steel nuts for bolting in nuclear reactors and associated applications where high temperatures and high pressures exist. (TFD)

25508 (RN-66258(Vol.1)) REMOTE MANIPULATORS AND MASS TRANSFER. Volume I. Technical Discussion. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 232p. Dep. NTIS $14.75.

This proposal was submitted by Aerojet-General Corporation to the Air Force Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio, in response to Request for Proposal Number F33615-67-R-1370, dated 3 October 1966, entitled: Remote Manipulators and Mass Transfer. The work program and the qualifications of Aerojet-General to carry out the work are discussed. (TFD)

25509 (RN-DR-0097) NERVA SUPPORT EQUIPMENT OPERATING AND MAINTENANCE INSTRUCTIONS FOR FUNCTIONAL VALVE AND LEAK TEST SET-4400. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1967. 53p. Dep. NTIS $5.75.

An instruction manual for operating and maintaining the Functional Valve and Leak Test Set is presented. This Test Set is used to perform functional and leak tests on the Nerva XE-Engine during assembly operations and prior to a test firing of a completed assembly. (LCL)

25510 (RN-DR-0150) FACILITY MODIFICATION LOGIC PROCEDURE. Project 223. Preliminary Draft. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Jan 1970. 7p. Dep. NTIS $4.00.

The logic procedure which must be followed for all Engine Test Stand-1 modifications, regardless of magnitude, is presented. (auth)

25511 (RN-DR-0191) ETS-1 GROUNDING SYSTEM, SITE TEST REPORT. Henson, C. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1970. 18p. Dep. NTIS $4.00.

Test methods and test results on the grounding of the NERVA Engine Test Stand No. 1 are reported. The ground-rod installations are considered marginal because the ground-rod resistances to earth measured at Manholes 3 and 5 were 29 and 60 ohms, respectively, as compared with a desired resistance of 5 ohms or less. It is therefore recommended that all ground rods be converted to chemical or wet ground rods so the resistance to ground can be maintained at a minimum level regardless of season, climate, or local environment. (TFD)

25512 (RN-FOP-0001) NERVA PROGRAM. Test Cell A, LH_2 Fill Station. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 3 May 1963. 18p. Dep. NTIS $4.00.

The instructions described in this procedure are typical for the operation of Test Cell A relative to the KIWI-B4A program. Operation of Test Cell A during the NRX tests will require modifications as dictated by specific requirements. Under NRX conditions, it will be the responsibility of the test cell manager to evaluate the capabilities of Test Cell A in terms of given test requirements and provide detailed checklists that fulfill those requirements. The purpose of this procedure is to acquaint operating personnel with typical techniques for local operation of the LH_2 Fill Station. Local operation includes all procedures required to assure functional integrity of the system and compatibility with test requirements. The contents of this procedure are intended for use by the test cell manager, systems engineers, and technicians responsible for the operation of the LH_2 Fill Station. (auth)

25513 (RN-FOP-0007) NERVA PROGRAM. Operating Procedure, Gas Systems, Test Cell A. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Oct 1963. 67p. Dep. NTIS $6.50.

The instructions in this procedure are typical for operation of Test Cell A (TCA) when the KIWI-B4A reactor is being tested. When Test Cell A is to be used for testing the NRX reactor, modifications to the instructions will be required, as dictated by specific test requirements. Before the NRX is tested, the test cell manager will be responsible for the evaluation of TCA capabilities in terms of the test requirements and then preparing detailed check lists that are compatible with the particular requirements. The purpose of this procedure is to acquaint operating personnel with typical techniques to be used for local operation of the gas system. Local operation includes the performance of all procedures required to assure functional integrity of the system and compatibility with the test requirements prior to transferring to remote control, and includes the securing of the system after remote control operation. The contents of this procedure are intended for use by the test cell manager, systems engineers, and technicians responsible for the functional integrity of the gas system. (auth)

25514 (RN-FOP-0010) TEST CELL A: HYDRAULIC SYSTEMS OPERATION. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1 Jun 1963. 40p. Dep. NTIS $5.00.

An operating procedures manual is presented for the hydraulic systems for Test Cell A which is used to test rocket propulsion reactors. (LCL)

25515 (RN-FOP-0011) NERVA PROGRAM. Operating Procedure, Compressed Air System, Test Cell C. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Aug 1963. 14p. Dep. NTIS $4.00.

The instructions in this procedure are typical of Test Cell A operation relative to the KIWI program. Operation of Test Cell A relative to the NRX reactor, requires modifications dictated by specific test requirements. Under NRX conditions, it is the responsibility of the test cell manager to evaluate the capabilities of Test Cell A in terms of given test requirements and set forth detailed checklists which are compatible with the test requirements. This procedure will acquaint operating personnel with typical techniques for local operation of the compressed air system. Local operation includes all procedures required to assure functional integrity of the system and compatibility with the test requirements. The contents of this procedure are intended for use by the test cell manager, systems engineers, and technicians responsible for the functional integrity of the compressed air system. (auth)

25516 (RN-S-0040) PROGRAM FOR CONTRACT YEAR 1964, NES ETS-1 UNCOOLED EXHAUST DUCT. Summary Report. (Aerojet-General Corp., Azusa, Calif. (USA)). Feb 1964. 125p. Dep. NTIS $9.25.

Work accomplished during the period from Oct. to Dec. 1963 on the NERVA Exhaust System (NES) Uncooled Duct Program for Engine Test Stand 1 (ETS-1) to demonstrate the adequacy of the NES design is summarized. During this period, 80% of the design analysis and 70 percent of the drawings were completed. Plans for fabrication, installation, and testing were formulated. (auth)

25517 (RN-S-0079) INTERDEPENDENT FACILITY AND CONTROL SYSTEMS. (Aerojet-General Corp., Azusa, Calif. (USA)). Apr 1964. 68p. Dep. NTIS $6.50.

The control and facility systems that are required to provide satisfactory testing of the NERVA engine in the Engine Test Stand No. 1 at Jackass Flats, Nevada are defined. These systems are described, and all work that has been completed, plus that which remains to be accomplished is presented. In addition, the need for a coordinated sequential activation plan for orderly completion of the site is discussed. (auth)

25518 (RN-S-0097) ASSEMBLY AND INSTALLATION PLAN OF THE NERVA EXHAUST SYSTEM DUCT AT ETS-1. (Aerojet-General Corp., Azusa, Calif. (USA)). Jun 1964. 27p. Dep. NTIS $4.50.

The requirements and procedures for the installation of the Nerva Exhaust System duct in the Engine Test Stand-1 are outlined. (auth)

25519 (RN-S-0123(Vol.4)) DESIGN ANALYSIS: MK 4 MOD 2 TURBOPUMP. Volume IV. Power Transmission (including bearings). (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1965. 52p. Dep. NTIS $5.75.

The design of the Mark IV Mod 2 turbopump is presented. This design was accomplished as a backup to the Mark III Mod 3 configuration with certain pump improvements and contingency features. This volume discusses the design analyses of the power transmission system. (auth)

25520 (RN-S-0131) PRELIMINARY RECOVERY REQUIREMENTS AND REMOTE HANDLING EQUIPMENT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1964. 102p. Dep. NTIS $8.25.

Types and quantities of remote handling equipment required to recover from a major nuclear rocket engine malfunction during ground test, or a malfunction of the EIV, MCC, locomotive or NES duct trailer during handling or transport of a hot NERVA engine or a hot NES duct are described. Preliminary operational procedures for recovering from malfunctions and preliminary design criteria for handling equipment also are included. (auth)

25521 (RN-S-0296) NES DESIGN DEMONSTRATION TEST PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1966. 50p. Dep. NTIS $5.50.

The second revision to the Design Demonstration Test Plan for the Nuclear Exhaust System (NES) for ETS-1 is presented. The Design Demonstration Test program provides for cold flow testing of the NES at both NERVA design and off-design conditions. These tests will be used to demonstrate the performance of NES prior to its use in supporting the testing of a nuclear engine. (auth)

25522 (RN-S-0340) X-ENGINE TSA/UTS REMOTE INTERFACE DEVELOPMENT. Johnson, H. J. Jr. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1966. 93p. Dep. NTIS $7.75.

Test results obtained in the development of the NERVA X-engine-to-test-stand remote interface are presented. Testing was performed at the Sacramento plant of Aerojet-General using a simulated test stand, upper thrust structure, a full-scale test stand adapter, X-engine weight and envelope mockup, and the manned control car and engine installation vehicle. As a result of the more than 150 interface tests performed, several modifications were made to the interface system and its components. The basic design, however, proved to be satisfactory: major system redesign was not required. The capability of the manned control car and engine installation vehicle to install the X-engine in the test stand and then to remotely remove it was demonstrated. (auth)

25523 (RN-S-0376(Vol.1)) OPERATING AND MAINTENANCE INSTRUCTIONS FOR XE-1 TEST STAND CONTROL (TSCS) ENGINE CONTROL SUBSYSTEM. Volume I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1968. 277p. Dep. NTIS $17.00.

Operating and maintenance instructions for the control systems of the NERVA program XE-1 test stand are presented. Information is included on the general description, installation procedures, theory of operation, maintenance and trouble shooting procedures for all the remote control equipment. (LCL)

25524 (RN-S-0379) EVALUATION OF E/STS 2 AND 3 SCALE-MODEL DIFFUSER-EJECTOR (DRY-ELBOW SYSTEM). Margetts, M. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1967. 94p. Dep. NTIS $7.75.

Scale-model tests were conducted to develop a minimum-length diffuser-ejector design for use in testing 5000- and 10,000-MW NERVA engines in a simulated space environment. The experiments simulated component parts of the E/STS-2 and E/STS-3 test-stand systems in approximately 1:20 scale and were conducted at the Aerojet-General Azusa facilities from February through September 1966. The component designs were altered systematically to determine the effects of various diffuser contraction angles, contraction ratios, throat lengths, turning-elbow radii, and downstream constriction ratios on starting conditions and operating efficiency. The system was evaluated by taking pressure measurements and determining wall heating effects. The study resulted in design recommendations for a diffuser-ejector system to be used in a full-scale test facility. (auth)

25525 (RN-S-0390) INTERIM NUCLEAR ANALYSES IN SUPPORT OF E/STS 2-3 TEST STAND PRELIMINARY DESIGN. Warman, E. A.; Rogers, D. R.; Foreman, D. L.; Whittum, H. O. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1967. 95p. Dep. NTIS $7.75.

Interim results are presented for the nuclear analysis activities in support of the preliminary design of E/STS 2-3. The period of work from 22 December 1966 through 14 April 1967 is covered. The results of earlier studies, in support of test facility layout activities, were reported in RN-TM-0415. This report documents the results of nuclear analyses in the following areas: (a) engine envelope and nuclear ground test module environment (with and without a facility intermediate shield), (b) test stand pad and service tower environment (with and without a facility side shield), (c) side shield radiation heating (with and without a facility intermediate shield), (d) materials activation, and (e) unshielded activation of the test pad and service tower. Conclusions are reached on the basis of the data presented and work in progress is discussed. (auth)

25526 (RN-S-0428) PERFORMANCE EVALUATION OF A MODIFIED NERVA TECHNOLOGY PUMP IN LIQUID HYDROGEN AT ZERO NPSP. Brunner, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 53p. Dep. NTIS $5.75.

Cavitation tests were conducted with a modified NERVA technology pump to determine the performance changes resulting from vapor ingestion appearing as a variation of flow rate at the inlet of a fixed-geometry, fixed-speed pump. Performance as a function of NPSH and flow rate, including favorable results at zero NPSP, and operational behavior of the positive NPSP pump are discussed. Back-vane performance is discussed in terms of static head coefficients. (auth)

25527 (RN-S-0454(ADD.1)) ETS-1 ELECTRICAL POWER SYSTEM FAILURE MODE ANALYSIS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1968. 121p. Dep. NTIS $9.25.

The electric power and distribution system of the Engine Test System-1 (ETS-1) for the NERVA program provides electric power to all facilities and test articles under normal and emergency conditions. The power system is described, and a detailed failure mode analysis of the ETS-1 electric power distribution system is presented. (LCL)

25528 (RN-S-0459) ETS-1 DATA ACQUISITION SYSTEM ACCURACY REPORT, FINAL. Benenson, H.; Cooper, R.; Porter, L. K. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1968. 165p. Dep. NTIS $11.25.

An analysis of the final test data obtained to determine the accuracy of the ETS-1 narrow and wide-band data systems is presented. A chronological listing of dates and documents that have supported the accuracy testing activities to date is presented. Information on test equipment used and major data subsystem components evaluated is tabulated. The final accuracy specification, RN-S-0308A, and the Addendum specification, RN-S-0308B, together with the respective NTO test procedures to support these specifications, are included in this report. (auth)

25529 (RN-S-0507) FLEXIBLE ENGINE SHIELDING TEST FACILITY STUDY. Warman, E. A.; Courtney, J. C.; Foreman, D. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1969. 38p. Dep. NTIS $5.00.

This study defines an experimental program and associated facility for the NERVA program to provide a means: (1) to obtain radiation data for design of facility and flight engine shielding; and (2) to verify and perform qualification testing of these shields. There is an interrelationship and commonality between the two shielding design problems which indicate the advisability of providing radiation data in a common experimental facility. The study is based on a recognition of the benefits of this overall approach, and suggests a phased program to obtain data to support both the engine and facility design efforts. The study recognizes the possible economic impact of the facility modification and test program upon the funding of the NERVA program. Thus, there has been an attempt to minimize the overall cost and to schedule the costs in a manner to minimize the impact on the NERVA program itself. In particular, although the total experimental shielding program is summarized, Part 1 of this study directs its immediate attention to the CY 1969 requirements. Upon acceptance of this concept, the second part of the study will be prepared to delineate the specifics of the proposed experimental program. (auth)

25530 (RN-S-0546) WATER DROPLET; SIZE DETERMINATION FOR BREAKUP OF LARGE DIAMETER JETS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1970. 108p. Dep. NTIS $8.50.

A series of nozzle tests in a wind tunnel have improved the understanding of how the water from spray nozzles and penetration nozzles is distributed in a cross flow of gas, and the droplet sizes that are generated. The drops generated by the breakup of water jets from nozzles ranging in diameter from 0.25 to 1.5 in. were photographed in a series of wind tunnel tests. The volume mean drop size generated in these tests was found to compare favorably with that calculated using the following empirical equation generated by Ingebo for nozzles 0.01 to 0.04-in. in dia: $D_{30}/D_0 = 3.9\ (We/Re)^{0.25}$. The maximum droplet diameter was found to be nominally 30% smaller than the droplets measured by Ingebo as correlated by the equation $D_{max}/D_0 = 22.3\ (We/Re)^{0.29}$. A series of mass distribution measurements have resulted in a new understanding of the quantity of water removed from the water jet as it penetrates a cross flow of gas. A graphical description of the mass distribution in terms of jet penetration is presented. A series of tests of flat spray nozzles indicates that the penetration is decreased by 50 or 60% of that attained with a penetration or fire hose nozzle. (auth)

25531 (RN-TM-0444) ETS-1 SIDE-SHIELD TRANSFER-CAR DYNAMIC ANALYSIS. Rosser, R. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1967. 77p. Dep. NTIS $7.00.

Dynamic Analyses of the ETS-1 side-shield transfer car were performed, including both resonance and response determinations for the car with the shield both empty and full of water. The response analyses are in the form of parametric studies in which the period of the braking force is varied. The most severe case, that of zero structural damping, is considered. (auth)

25532 (RN-TM-0553). E/STS 2-3 STEAM REQUIREMENTS. Patmor, G. O.; Uecker, R. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1967. 52p. Dep. NTIS $5.75.

The methods used to obtain the E/STS 2-3 NES steam requirements are described. Also included are Appendix A, which describes the computer program used in the computations, and Appendix B, which describes the method of calculation used to obtain the program inputs. (auth)

25533 (RN-TM-0591) ETS-1 ACOUSTIC MODIFICATION-STRESS ANALYSIS. O'Callaghan, T.; de la Garza, W.; Pickering, J. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 101p. Dep. NTIS $8.25.

This report presents the stress analyses that were performed for portions of ETS-1. The original design required modifications because of loading conditions that were not initially anticipated. The principal portion of ETS-1 for which design changes had to be made was the duct-vault inerting wall. During early testing local gas explosions occurred near the duct exit during periods of low hydrogen flow in the duct. Because of the duct's long, tubular design it was also suspected that it would be driven as a low-frequency whistle by any flow irregularities which would sustain a resonant condition in the duct. This noise source could be more severe than that arising from the conventional noise of the exhaust jet. Revised environmental design criteria were prepared by P. S. Veneklasen and Associates and by NRO Sacramento personnel. These criteria showed that it would be advisable to strengthen the duct-vault inerting wall by utilizing stronger aluminum paneling with vibration-damping material and additional bracing members. In addition, the method of supporting the water-deluge system for the wall was altered so the wall no longer supports the system at intermediate points. Inspection of the upper heat

shield showed that several of the screws attaching the paneling to structural members had worked loose and Huckbolt type fasteners were added as an additional precautionary measure. No modifications were required for the moveable weather door because of the strong acoustical-damping characteristics of the door's heat-insulating material. A vibration survey of the original wall, the upper heat shield, and the moveable weather door was made. The survey provided information on natural frequency and damping characteristics of the original installations. The report is divided into five sections, one each for the duct-vault inerting wall, the upper heat shield, the moveable weather door, the pipe-chase inerting wall, and the water piping system of the duct-vault inerting wall. (auth)

25534 (RN-TM-0593) ETS-1 ACOUSTIC MODIFICATION DETONATION TEST EVALUATION. O'Callaghan, T. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1970. 21p. Dep. NTIS $4.25.

A series of charges were detonated in free air at points along the exhaust axis of the nuclear exhaust system (NES) duct of the NERVA Engine Test Stand-1. Responses to these detonations were recorded by the accelerometers, strain gages, and microphones mounted on the inerting wall, the movable weather door, and the upper heat shield. Stress data and natural frequency data are presented. (auth)

25535 (RN-TP-0006) NOZZLE HOT BLEED PORT SEAL EVALUATION. Coppo, R. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Jun 1966. 10p. Dep. NTIS $4.00.

The plan for the development, evaluation, and qualification testing of a seal for the NERVA Hot Bleed Port-Nozzle interface is described. The objective of this test series is to provide data, evaluate and qualify the sealing capabilities of an "O" val Seal, an E-Seal, an Omega Seal, a K-Seal and a spiral wound asbestos-filled gasket for the Hot Bleed Port-Nozzle interface. The results of this test series will qualify a seal to be used in future hot bleed port nozzles. (auth)

25536 (RN-TP-0009) DEMONSTRATION TEST PLAN FOR X-ENGINE SYSTEM 5" BUTTERFLY VALVE. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 26p. Dep. NTIS $4.50.

A plan for testing to demonstrate that the 5 in. butterfly valves will meet the requirements for use in the X-engine system, and test conditions for demonstrating acceptability for use with the NERVA X-engine system are presented. These conditions are compared to the valve design requirements. (auth)

25537 (RP-TR-0011) MILESTONE NO. 1 TEST SERIES 1.2-08-NNJ. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1967. 93p. Dep. NTIS $7.75.

This report documents Test Series 1.2-08-NNJ on Test Stand H-4B with film-cooled nozzle test-assembly S/N 880607. Testing was conducted with liquid oxygen and liquid hydrogen. Milestone No. 1 of Contract SNPC-35 was achieved in the fifth test when steady-state firing was maintained for 6.38 s at chamber pressures greater than 675 psia and at a mixture ratio between 5.25 and 5.75. The multiorifice injector, the nozzle-to-injector adapter, and the igniter assembly were proven to be suitable for Phoebus-2 nozzle testing. All facilities and equipment systems used were in operable condition at test-series conclusion. (auth)

25538 (TID/SNA-32) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Design Drawings, F008-NAS01-W224. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 74p. Dep. NTIS $6.75.

Detail and assembly drawings of the preliminary design of the exhaust duct system for the NERVA Altitude Simulation System (NASS) are presented. (LCL)

25539 (TID/SNA-97) ENGINE TEST STAND-1 (ETS-1). FEI-Part I Specification Design Criteria, F007. Basic Formating Sample Project 223. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Jan 1970. 27p. Dep. NTIS $4.50.

The basic facility design criteria that control the modification and upgrading of Engine Test Stand-1 to support the NERVA engine test program are presented. The detailed subsystem or the component design criteria are not included. (auth)

25540 (TID/SNA-119) PERFORMANCE DESIGN AND PRODUCT CONFIRMATION REQUIREMENTS FOR STEAM GENERATION AND DELIVERY SYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1970. 48p. Dep. NTIS $5.50.

This specification establishes the requirements for the performance, design, testing, and qualification of equipment identified as the Steam Generation and Delivery System (SGDS). This CEI, part of the NERVA Altitude Simulation System (NASS), is used to provide steam as a pumping fluid to the secondary ejector of the NASS Exhaust Duct System (EDS), DS90221, which is to be used on the Engine Test Stand No. 1 (ETS-1) facility in support of the NERVA Program. This CEI includes steam generators, steam line, instrumentation and controls, and associated valves, piping, structural members, and supports. (auth)

25541 (TID/SNA-123(Vol.3)) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design, PDR F008-NAS01-W224. Volume VII. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 129p. Dep. NTIS $9.50.

One-hundred-fourteen "Vu-graphs" which illustrate the design, design criteria, operation and performance characteristics, physical characteristics and arrangement, analyses performed, and corrective action plans related to the preliminary design of the Exhaust Duct System of the NERVA Altitude Simulation System are presented. (LCL)

25542 (TID/SNA-155) SUPPLEMENTAL DESIGN CRITERIA. NRDS Test Cell "A". NERVA Turbopump 65MM Bearing Test Facility. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1971. 46p. Dep. NTIS $5.50.

Design criteria for the NERVA turbopump 65 mm liquid H_2-cooled bearing test facility are presented. Information is included on: ball and roller bearing description; tester design and operation; overall test program; quality assurance and safety; related test facility systems; design review; and readiness verification. (LCL)

25543 (TID/SNA-161) SPACE-FLIGHT MATERIAL-HANDLING DEVICES. Folder 1. Technical Proposal and Program Plan. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). May 1968. 177p. Dep. NTIS $12.00.

A proposal is presented for the development of an experimental materials handling device (EMHD) for use in space construction activities and for the preliminary design of a man-rated flight material-handling device based on the results of the EMHD concept evaluation tests. (LCL)

25544 (TID/SNA-214) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR STRUCTURAL SUPPORT BLOCK VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

This specification establishes the performance, design, test and qualification requirements for equipment identified as Structural Support Block Valve and Actuator (SSBV) consisting of a valve and an electromechanical actuator system. The SSBV assembly is to permit flow to the structural support assembly during engine operation and to permit flow to the pressure vessel reflector annulus during engine cooldown. (auth)

25545 (TID/SNA-250) WATER DROPLET SIZE DETERMINATION FOR BREAK UP OF LARGE DIAMETER JETS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. Contract SNP-1. 68p.

A series of nozzle tests in a wind tunnel has improved the understanding of how water from spray and penetration nozzles is distributed in a cross flow of gas, and how water-droplet sizes are generated. The drops generated by the break up of water jets from nozzles ranging in diameter from 0.25 to 1.5 in. were photographed in a series of wind-tunnel tests. The volume mean drop size generated in these tests compared favorably with that calculated using the following empirical equation generated by Ingebo for nozzles of from 0.01 to 0.04-in. in dia: $D_{30}/D_0 = 3.9\ (We/Re)^{0.25}$. The maximum droplet diameter was nominally 30% smaller than the droplets measured with the Ingebo method as correlated by the equation $D_{max}/D_0 = 22.3\ (We/Re)^{0.29}$. A series of mass-distribution measurements has resulted in a new understanding of the quantity of water removed from the water jet as it penetrates a cross flow of gas. An empirical expression is presented that characterizes the water-jet mass distribution in a cross flow of gas. The correlation is a modification of the expression generated by Clark, i.e., $q/q_0 = [a(\epsilon_M - 1)^n + 1]^{-1.0}$. A series of tests of flat-spray nozzles indicates that the penetration is decreased to 50 to 60% of that attained with a penetration or fire-hose nozzle. (auth)

25546 (TID/SNA-295) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Aerodynamic and Thermodynamic Analysis, F008-NAS01-W224. Appendix A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 389p. Dep. NTIS $22.50.

Scale model testing and analyses and design analyses to determine the aerodynamic and thermodynamic characteristics of flow in the turning plenum and the secondary ejector of the NERVA Altitude Simulation System (NASS) Exhaust Duct System are presented. A design analysis of the NASS system with such items as thrust acoustic effects and system dynamics is included. (LCL)

25547 (TID/SNA-297) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Dynamic Analysis, F008-NAS01-W224. Appendix C. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 46p. Dep. NTIS $5.50.

The preliminary dynamic analysis for the NASS EDS was conducted. This analysis resulted in the establishment of the dynamic model and the determination of the natural frequencies and mode shapes of vibration for the NASS duct. The dynamic model includes the primary ejector, turning plenum, secondary ejector, and subsystems' components attached thereto. The fundamental frequency of vibration is 7.45 Hz (T = 0.134 sec.) and occurs as a half-wave mode shape in the secondary ejector. It was determined that only the fundamental frequency (natural period = 0.134 sec.) is in major resonance with the basic ground motion of the design seismic event. Prior to final design review a transient dynamic response analysis will be conducted and the fundamental mode may be eliminated by the addition of intermediate supports at the midspan of the secondary ejector. From a structural reliability viewpoint, it would be prudent to add such supports not only to eliminate the seismic resonance condition but also to considerably enhance the ability of the duct to withstand a more severe "off design" seismic event should such occur. Sources of vibration during system operation, such as pressure fluctuations, fluid flow fluctuations, acoustic energy, etc., have been determined and the dynamic response analysis of these loads will be conducted prior to final design review. (auth)

25548 (TID/SNA-298) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Nuclear Analysis, F008-NAS01-W224. Appendix D. (Aerojet-Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 20p. Dep. NTIS $4.00.

The principal contributions to the NASS Exhaust Duct System (EDS) study were in calculations of radiation levels in the duct vault; heating rates in the EDS; of activation of the AGCarb Duct Collar; and of the utility of the water shield. An examination of the drawings revealed no readily apparent nuclear problems. The duct vault concrete heating rates were low enough without the water shield to indicate that the shield may not be needed. It must be recognized that the thermal analysis of the exhaust duct, using the calculated heating rates, could reveal problem areas that could require further nuclear analysis and/or mechanical redesign. (auth)

25549 (TID/SNA-299) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Hazards Analysis, F008-NAS01-W224. Appendix E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 24p. Dep. NTIS $4.25.

The results and conclusions of a hazard analysis conducted on the NERVA Altitude Simulation System (NASS) and the Exhaust Duct System (EDS) are presented. The analysis consisted of a systematic evaluation of the elements of the duct system, highlighting potential failure points, to ensure that adequate safety considerations have been incorporated in the design. This study represents an updating of the preliminary NASS hazard analysis completed in May 1969. Included are a narrative description of the NASS duct, a summary statement giving the conclusions of the safety evaluation, and the hazard analysis worksheets. (auth)

25550 (TID/SNA-300) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Reliability Analysis, F008-NAS01-W224. Appendix F. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 92p. Dep. NTIS $7.75.

The preliminary Failure Mode Effects and Criticality Analysis (FMECA) of the NASS Exhaust Duct System (EDS) is presented, based on the preliminary EDS design, and an evaluation of the significant failures associated with the Exhaust Duct System Operation is provided. Action items to correct, eliminate, reduce, or monitor the possible failure modes are identified. Failure effects are categorized from I for minimal effect, to IV for the most serious effects relative to counteractions possible and repairability of damage. (auth)

25551 (TID/SNA-342) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Facility Interface Sheets (S-58), F008-NAS01-W224 Volume IV. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 30p. Dep. NTIS $4.50.

The preliminary facility interface data sheets (S-058) were completed on the basis of NASS EDS preliminary design drawings and analysis. The first sheet contains data relative to the complete duct assembly, such as total EDS dimensions, weight, and environment. The subsequent sheets provide data for separate EDS components and include handling and installation requirements. The environmental data are complete except for vibration data and for exhaust plume temperature and distribution data. A proposed instrumentation location selection was made for the NASS EDS. Instrumentation selection was made based on the requirements for EDS control and monitoring, diagnostic data, and safety. (auth)

25552 (TID/SNA-349) FLIGHT AND GROUND TEST CONTROL INTEGRATION PLAN, m110-GIP08-W227. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1971. 56p. Dep. NTIS $6.00.

The functions to be accomplished in providing the control system in support of the NERVA engine testing at ETS-1 are described. This provides information to the project engineer for the planning and design of a unit of Test Support Equipment identified as the Ground Test Control System (GTCS). The overall Engine Control System integration studies required and programs used as guides by the equipment and system designers are discussed. (auth)

25553 (TID/SNA-359) SYSTEMS FUNCTIONAL REQUIREMENTS DOCUMENT FOR THE ETS-1 TEST STAND CONTROL SYSTEM, SUBTASK 2.2.8. Appendix 2. (Aerojet-General Corp., Sacramento, Calif. (USA)). 4 Jun 1965. 41p. Dep. NTIS $5.25.

Engine Test Stand Number 1 (ETS-1) was designed and built as the first half of a dual test facility (ETS-1 and ETS-2) in which test operations could be performed on one test stand while pretest and posttest work was being performed on the other. As originally conceived, large portions of the control and data acquisition equipment would be shared by both test stands. Changes in the program, however, deleted ETS-2, so that the facility is presently being designed for single stand needs only. ETS-1 is designed to provide the facilities and environment required to meet the test objectives outlined for ground testing the NERVA Engine. To achieve this purpose an extensive array of facilities is required. To activate the facility, SNPO has contracted to provide a data acquisition system and certain controls for the existing facility. This is commonly referred to as the I & C (Instrumentation and Controls) Package. As engine facility and interface requirements were determined, the package known as the Facilities-to-Thrust Structure Interface System was developed. The TSCS is the system which then completes the overall control and monitoring requirements by providing an overall integration of the facility and engine control and monitoring systems. (auth)

25554 (TID/SNA-367) ENGINEERING DESIGN SHEET: DESIGN AND TEST REQUIREMENTS FOR NASS EXHAUST DUCT SYSTEM. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 49p. Dep. NTIS $5.50.

The design requirements for the Exhaust Duct System (EDS) of the NERVA Altitude Simulation System (NASS) as installed in Engine Test Stand-1 at NRDS, Jackass Flats, Nev. are defined. These requirements cover performance, operability, reliability, maintainability, capability to withstand environmental conditions, transport, safety, remote control, interface requirements, materials, construction, drawings, and specifications. (LCL)

25555 (TID/SNA-451) ENGINE TEST STAND NO. 1 (ETS-1) FACILITY REQUIREMENTS DOCUMENT, F004-CP090290-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. 94p. Dep. NTIS $7.75.

The basic facility requirements necessary to support the NERVA program for the development and qualification engine test program at Engine Test Stand Number One (ETS-1) are presented. A reference engine has been established with sufficient definition to prepare facility requirements for design, procurement, scheduling, and budgetary purposes since facility considerations primarily involve the test article envelope and interfaces. (auth)

25556 (TID/SNA-454) FACILITY REQUIREMENTS DOCUMENT: NRDS TEST CELL "A" NERVA TURBOPUMP 65MM BEARING TESTING FACILITY REQUIREMENTS, F004CP091295-BG1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1971. 25p. Dep. NTIS $4.25.

The Test Cell "A" facility and Special Test Equipment requirements necessary to support the evaluation testing of LH_2-cooled 65mm rolling element bearings for the NERVA Turbopump Assembly are described. (auth)

25557 (TID/SNA-456) FACILITY REQUIREMENTS DOCUMENT: NRDS TEST CELL "C" SINGLE NERVA TURBOPUMP FACILITY, F004-CP091149BG1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1971. 53p. Dep. NTIS $5.75.

Requirements for the design and operation of a facility for performance testing the NERVA turbopump are presented. (LCL)

25558 (TID/SNA-459) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Design Report. Volume I. Kawashige, C. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 254p. Dep. NTIS $15.75.

The status of the NASS Exhaust Duct System design as of May 1971 is presented and analyses conducted to support the design effort are summarized. (LCL)

25559 (TID/SNA-461) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Fabrication Specification No. 210-3352-G-002. Volume III. Sternberg, R. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 190p. Dep. NTIS $12.50.

All documents required for a bid package for the fabrication of the NASS Exhaust Duct System are included. Fabrication and testing specifications for materials and fabricated components are presented. (LCL)

25560 (TID/SNA-462) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Facility Interface Sheets (S-058). Volume IV. Lichtenberger, R. V. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 39p. Dep. NTIS $5.00.

The Preliminary Facility Interface sheets are based upon the NASS EDS preliminary design. Data for separate EDS components is provided. Information related primarily to the environmental requirements and effects of the EDS and its components, and to the design requirements for those facilities interfacing with EDS is included. (auth)

25561 (TID/SNA-465) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Aero/Thermo Analysis. Appendix A. Book 1 of 3. (Addendum 2, to Appendix A). Margetts, M. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 386p. Dep. NTIS $22.50.

Analyses performed during the period from Oct. 70 to May 71 of design and scale model test data in order to determine the aerodynamic and thermodynamic characteristics of the primary ejector, turning plenum, and secondary ejector of the Exhaust Duct System of the NASS are presented. (LCL)

25562 (TID/SNA-466) NERVA ALTITUDE SIMULATION SYSTEM, F008-NAS02-W224. Exhaust Duct System Preliminary Design. Preliminary Aero/Thermo Analysis. Appendix A. Book 2 of 3. (Addendum 2, to Appendix A F008-NAS01-W224). Margetts, M. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 225p. Dep. NTIS $14.25.

Work accomplished during the period from Oct. 1970 to May 1971 in defining the aerodynamic and heat transfer characteristics of the exhaust duct system (EDS) of the NERVA altitude simulation system is described. Information from the design analysis of the primary ejector is included. (LCL)

25563 (TID/SNA-470) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Nuclear and Radiation Effects Analysis. Appendix D (Addendum 1 to Appendix D). Kawashige, C. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 31p. Dep. NTIS $4.75.

Specific analyses were performed to ensure that the Exhaust Duct System (EDS) had the capability to survive the nuclear radiation environment to which it would be exposed. The analyses are summarized. (auth)

25564 (TID/SNA-472) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Design, Materials, Q. A., and Manufacturing Evaluations. Appendix G. Kawashige, C. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 268p. Dep. NTIS $16.50.

Quality assurance and manufacturing evaluations performed to provide information for design evolution, to verify the adequacy of the selected design, and to provide data for structural and thermodynamic analyses are presented. (LCL)

25565 (TID/SNA-474) STATUS REVIEW: NERVA ALTITUDE SIMULATION SYSTEM, EXHAUST DUCT SYSTEM PRELIMINARY DESIGN, f008-NSR-03-W226. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1971. 109p. Dep. NTIS $8.50.

Completed work and recommended final design work on the exhaust duct system for the Nerva Altitude Simulation System is summarized. All applicable documents are included. (LCL)

25566 (TID/SNA-478) NERVA TURBOPUMP BEARING SPECIAL TEST EQUIPMENT REQUIREMENTS, m100-STE09-W361f1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. 27p. Dep. NTIS $4.50.

Design criteria for the NERVA turbopump 65mm liquid-H_2-cooled bearing test facility are presented. Information is included on: ball and roller bearing description; tester design and operation; overall test program; qualitity assurance and safety; related test facility systems; design review; and readiness verification. (LCL)

25567 (TID/SNA-491) GIMBAL PIVOT ASSEMBLY DESIGN STUDY. Engineering Operations Report. Bronner, H. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 69p. Dep. NTIS $6.50.

The concept design and analysis for the gimbal pivot assembly of the 75K NERVA engine are documented. This design study examined the effect of materials properties on the size and stiffness of the gimbal pivot assembly. The specific effect of Young's modulus and material strength is discussed. A conceptual introduction to a backup design suitable for installation in the space allotted to the gimbal pivot assembly in the engine concept is presented. The nuclear, thermal, stress, weight, and dynamic analyses made for the gimbal pivot assembly as a unit or as a part of the engine assembly; and finally, fabrication methods are discussed. (auth)

25568 (TID/SNA-501) PRELIMINARY ANALYSIS OF ETC/NASS DYNAMIC REPRESSURIZATION AND AIR INTRUSION CHARACTERISTICS, s038-EDS01-W224f. Bailey, W. G.; Thompson, W. R.; Mockenhaupt, J. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1971. 84p. Dep. NTIS $7.25.

Altitude simulation for ground testing of the NERVA engine is accomplished by partially evacuating an Exhaust Duct System (EDS) which encloses the engine and contains its exhaust gases before venting them to the atmosphere. The engine is enclosed in the Engine Test Compartment (ETC) while the NERVA Altitude Simulation System (NASS) constrains the flow of the nozzle effluent. The total volume so enclosed is approximately 30,000 ft^3. Depending on the point in time in the engine test cycle, much of this volume is at subatmospheric pressure. Loss of motive fluid maintaining the resulting pressure differential results in fluid surges within the system as it repressurizes; the magnitude and frequency of these pressure oscillations depend both on the mechanism and the time-rate-of-change of the loss of driving fluid. These pressure surges can be of a magnitude which exceeds the stress limitations of system components; the ETC in particular is limited to an overpressure of 2 psig. Further, the repressurizing fluid can be air back-flowing into the NASS which introduces the hazard of combustion and/or explosion within the system as the nozzle hydrogen exhaust mixes with the repressurizing air. The objective of this report is to present the results of a preliminary analysis of these hazards. (auth)

25569 (TID/SNA-510) ENGINEERING OPERATIONS REPORT: ANALYSIS OF SPACE SOAK THERMAL EFFECTS. Project 110. Thompson, W. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1972. 56p. Dep. NTIS $6.00.

The results of the thermal analyses performed in response to the "Coating Action Item" generated following the Engine/Component Design Status Review (E/CDSR) held in April 1971 are presented. These analyses provide the thermal time constant of the engine in space soak condition, evaluate the effects of circumferential conduction to shaded sides of thrust structure, pressure vessel, etc., provide the effects of surface finish of pressure vessel aluminum and thrust structure titanium components on the absorptivity emissivity ratio for sunlight, and assess the effect of the earth's albedo. (auth)

25570 (TID/SNA-542) NES DUCT PRESENTATION TO SNPO-C AT CLEVELAND ON 7 MAY 1963. (Aerojet-General Corp., Azusa, Calif. (USA)). May 1963. 14p. Dep. NTIS $4.00.

The duct materials, coolant passage configuration, coolant flow rates, and fabrication status of the Engine Test Stand-1 (ETS-1) of the NERVA Exhaust System Duct are reviewed. It was intended that a single choice of material and passage configuration be selected as a basis of the preliminary design effort during 1963. (auth)

25571 (TID/SNA-547) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Design Drawings. Volume II. Sternberg, R. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 71p. Dep. NTIS $6.75.

25572 (TID/SNA-548) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Fabrication, Specification No. 210-3352-G-002. Volume

III. Sternberg, R. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 291p. Dep. NTIS $17.75.

Nine documents containing specifications for the fabrication and testing of the Nerva Altitude Simulation System Exhaust Duct System are presented. These documents are required for a bid package for fabrication contractors. (LCL)

25573 (TID/SNA-549) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Hazards/Reliability Analysis, F008-NAS02-W224. Appendix E/F. Lichtenberger, R. V. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 119p. Dep. NTIS $9.00.

The preliminary hazard and reliability analysis performed on the exhaust duct system (EDS) of the NERVA Altitude Simulation System (NASS) in order to assure acceptability of the EDS design to structural, performance, quality, and operational requirements is presented, EDS failures which could potentially cause critical hazards to the EDS or to the test facility and/or engine are identified, and the conditions which could cause such EDS failures are described. (LCL)

25574 (TID/SNA-551) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Conceptual Design Drawings and Layouts List. Appendix H (Addendum I to Appendix H, F008-NAS01-W224). Sternberg, R. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 8p. Dep. NTIS $4.00.

This addendum includes a list of all conceptual and layout drawings produced since the August 1970 Preliminary Design Review of the Exhaust Duct System of the NERVA Altitude Simulation System. Sixty-eight drawings are listed including drawings of the collar, primary ejector, turning plenum, water injection subsystem, deflector plate, plenum support, and the secondary ejector. (auth)

25575 (TID/SNA-552) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Design, Materials, Q. A., and Manufacturing Evaluations. Appendix G. Kawashige, C. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 257p. Dep. NTIS $16.00.

Preliminary design, materials, quality assurance, and manufacturing evaluations are presented which were performed to: provide information for the design evolution; verify adequacy of the selected design; and to provide data for structural and thermodynamic analyses. A narrative is provided for each section summarizing the results of the work documented in the enclosed attachments. (auth)

25576 (TID/SNA-593) ANSC TELEOPERATOR RESEARCH SUGGESTIONS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1971. 69p. Dep. NTIS $6.50.

25577 (TID/SNA-595) SNPO-C NOZZLE DESIGN REVIEW. (Aerojet-General Corp., Azusa, Calif. (USA)). 22 Jan 1964. 56p. Dep. NTIS $6.00.

25578 (TID/SNA-613) TEMPERATURE MEASUREMENT SYSTEMS. Chandon, H. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Feb 1964. 76p. Dep. NTIS $7.00.

Three temperature measurement systems, the Thermocouple System, Bridge-in-head Ambient Resistance Temperature Transmitter (RTT) System and the Cryogenic Constant Current (RTT), used in the Liquid Rocket Plant Test Area are discussed. Information is included on the design, operating characteristics, installation, calibration, and data reduction of each system. (LCL)

25579 (TID/SNA-623) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Dynamic Analysis, F008-NAS02-W224. Appendix C. Vronay, D.; Michaux, B. B. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 89p. Dep. NTIS $7.50.

The preliminary structural synamic analysis of the NASS Exhaust Duct System (EDS) performed in support the preliminary structural design is presented. The basic analytical technique employed was the normal mode method. A finite-element model of the EDS structure was constructed to determine the normal modes which were then used to determine dynamic response. All analyses were performed with the NASA NASTRAN computer program and the ANSC IBM 360/65 computer. (auth)

25580 (TID/SNA-692) CONTRACT END ITEM REPORT. Manned Control Car, Part No. 89-73-1000. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1968. 232p. Dep. NTIS $14.75.

The following report supplements the AMF Narrative End Item Report dated January 12, 1965, and describes the final configuration status of the Manned Control Car (MCC). Certification and other documentation is provided attesting to the as-built configuration. A description is provided of the design and development changes, fabrication, factory testing, installation, checkout and final acceptance testing of the MCC as provisioned under Work Statement Subtask 2.1 of Aerojet-General Corporation (AGC) Contract SNP-1. Section I provides the configuration and design control records; Section II provides the certification and inspection records. (auth)

25581 (TID/SNA-694) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Design Report, F008-NAS01-W224. Volume I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 51p. Dep. NTIS $5.75.

The following information on the Exhaust Duct System (EDS) of the NERVA Altitude Simulation System (NASS) is presented: definitions of NASS/EDS design criteria; summary of NASS scale model test results; description of preliminary design; and recommendations for future efforts. (LCL)

25582 (TID/SNA-695) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Fabrication Specification No. 210-3352-G-002. Volume III. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 143p. Dep. NTIS $10.25.

The preliminary draft of the NASS Exhaust Duct System Fabrication and Testing Specification, 210-3352-G-002, Section 13D, Attachment 1, is presented which is based on the EDS design requirements contained in SO57-DS090221B-EA, EDS Design and Test Requirement Specification. The fabrication specification is in accordance with the CSI format as modified for application to the NRDS/ETS-1 modification task specifications. The suggested Special Conditions Section, Attachment 2, is a preliminary draft of a contractually-oriented document containing requirements peculiar to the EDS fabrication and installation which are not covered in the general contractual documents, nor contained in the technical specifications. All information for a preliminary bid package except "Instructions to Bidders" and contract drawings are included in this preliminary draft of specifications. (auth)

25583 (TID/SNA-715) NERVA ALTITUDE SIMULATION SYSTEM, F008-NAS02-W224. Exhaust Duct System Preliminary Design. Preliminary Nuclear and Radiation Effects Analysis. Appendix D (Addendum 1 to Appendix D, F008-NAS01-W224). Kawashige, C. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 31p. Dep. NTIS $4.75.

Specific analyses were performed to ensure that the Exhaust Duct System (EDS) of the NERVA Altitude Simulation System (NASS) could survive the nuclear radiation environment to which it would be exposed. Information is included on: re-evaluation of the gamma-heating rates used as design criteria; radiation degradation of AISI 347 and 304 stainless steels and radiation effects analysis of AISI 347 stainless steel in the upper and lower ejector walls of the NASS. (LCL)

25584 (TID/SNA-720) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Design Drawings, F008-NAS01-W224. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 74p. Dep. NTIS $6.75.

25585 (TID/SNA-722) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Aero/Thermo Analysis. Appendix A. Book 1 of 3. (Addendum 2, to Appendix A, F008-NAS01-W224). Margetts, M. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 390p. Dep. NTIS $22.50.

Work accomplished during the period from Oct. 1970 to May 1971 in defining the aerodynamic and heat transfer characteristics of the exhaust duct system (EDS) preliminary design for the NERVA Altitude Simulation System (NASS) is described. Information is included on: the scale model testing and analysis of primary ejector and the turning plenum; the secondary ejector; and analysis of the NASS/EDS system performance. Scale model testing data and analysis results for the primary ejector are included. (LCL)

25586 (TID/SNA-724) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Facility Interface Sheets (S-058). Volume IV. Lichtenberger, R. V. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 41p. Dep. NTIS $5.25.

The Preliminary Facility Interface sheets presented are based upon the NASS EDS preliminary design and contain data relative to the EDS assembly. Data for separate EDS components are provided. The environmental requirements and effects of the EDS and its components on the environment and the design re-

quirements for those facilities interfacing with EDS are included. The environmental data are complete except for exhaust-plume temperature and temperature distribution. (auth)

25587 (TID/SNA-763) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Facility Interface Sheets (S-58), F008-NAS01-W224. Volume IV. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 30p. Dep. NTIS $4.50.

The preliminary facility interface data sheets for the NERVA Altitude Simulation System (NASS) Exhaust Duct System (EDS) were completed on the basis of NASS/EDS preliminary design drawings and analysis. The first sheet contains data relative to the complete duct assembly, such as total EDS dimensions, weight, and environment. The subsequent sheets provide data for separate EDS components and include handling and installation requirements. The environmental data are complete except for vibration data and for exhaust plume temperature and distribution data. Significant data yet to be defined include some water flow rates, water control requirements, detailed safety provisions and weight information. Interface requirements with the plenum water removal system, the vault inerting wall, and the ignitors are to be determined. A proposed instrumentation location selection was made for the NASS EDS. Instrumentation selection was made based on the requirements for EDS control and monitoring, diagnostic data, and safety. (auth)

25588 (TID/SNA-768) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Conceptual Design Drawings and Layouts. Appendix H. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 12p. Dep. NTIS $4.00.

A list is presented of 187 conceptual and candidate configuration layout drawings produced during the design evaluation of the NASS Duct since inception. Drawings of duct arrangement, collar, primary ejector, carrying truss, plenum, water injection system, deflector plate, plenum support, steam system, secondary ejector, work platforms, and various miscellaneous drawings are listed by drawing number and title. (auth)

25589 (TID/SNA-787) THREE DIMENSIONAL PHOTOELASTIC ANALYSIS OF A FIVE-INCH BUTTERFLY VALVE LIP-SEAL (P/N 1117995-11). Campbell, D. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). 9 Nov 1968. 21p. Dep. NTIS $4.25.

The elastic stress distribution caused by seating and pressure in the 5 inch butterfly valve lip-seal has been determined by photoelastic analysis. Two three-dimensional photoelastic models were used to test for these conditions separately. For the seating condition simulating a closed valve with no pressure acting, a large region of the seal is stressed well above the elastic limit for the material. Suggestions are made for estimating the actual stress level from indicated elastic values. For the pressure condition simulating a transient condition as the valve opens against a 1200 psi pressure, all stresses are below yield stress except very locally near the retaining ring clamp. (auth)

25590 (TID/SNA-789) ENGINE TEST STAND NO. 1 (ETS-1) FACILITY REQUIREMENTS DOCUMENT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1970. 87p. Dep. NTIS $7.50.

The basic facility requirements necessary to support the NERVA program for the development and qualification engine test program at Engine Test Stand Number One (ETS-1), Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada are presented. (auth)

25591 (TID/SNA-790) ENGINE TEST STAND NO. 1 (ETS-1) FACILITY REQUIREMENTS DOCUMENT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1971. 94p. Dep. NTIS $7.75.

The basic facility requirements necessary to support the NERVA program for the development and qualification engine test program at Engine Test Stand Number One (ETS-1), Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada are presented. (auth)

25592 (TID/SNA-791) ENGINE TEST STAND NO. 1 (ETS-1) FACILITY REQUIREMENTS DOCUMENT. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. 94p. Dep. NTIS $7.75.

The basic facility requirements necessary to support the NERVA program for the development and qualification engine test program at Engine Test Stand Number One (ETS-1), Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada are presented. A reference engine has been established with sufficient definition to prepare facility requirements for design, procurement, scheduling, and budgetary purposes since facility considerations primarily involve the test article envelope and interfaces. (auth)

25593 (TID/SNA-810) PRODUCT ASSURANCE PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 60p. Dep. NTIS $6.00.

The policy and general procedures for meeting the quality assurance specifications for hardware and documentation generated on the non-nuclear portion of the NERVA program are described. (LCL)

25594 (TID/SNA-815) PAPER Q-6: DESIGN AND DEVELOPMENT OF A TEST FACILITY FOR THE DISPOSAL OF HYDROGEN AT HIGH FLOW RATES. Thompson, W. R.; Boncore, C. S. (Aerojet-General Corp., Sacramento, Calif. (USA)). 13 Jun 1966. 21p. Dep. NTIS $4.25.

Rocket nozzles developed for nuclear testing at the Nevada Test Site under the NERVA and Phoebus programs are first performance-evaluated in chemical simulation firings. In these tests, the nozzle is coupled to a modified liquid rocket injector by an adapter section which serves as a combustion chamber for liquid oxygen-liquid hydrogen combustion. Normally, in liquid rocket systems, the hydrogen so injected is first utilized to regeneratively cool the nozzle. In the case of the nuclear nozzles under development, however, the total coolant flow exceeds that required for simulation combustion; thus, an appreciable quantity of the coolant must be disposed of in a separate facility. Chemical testing of the Phoebus-2 nozzle requires disposing of up to 250 lb/s of nozzle coolant hydrogen in a safe and controlled manner. Combustion with atmospheric oxygen is the only feasible method to dispose of gas vented at these high flow rates over about a 17 to 20 s period. The so-called "burn-pond" method for disposal of the excess hydrogen is described. Essentially, this is a system in which the nozzle coolant hydrogen is ducted to an area sufficiently remote from the test stand, and dispersed through a pipe manifold submerged in water to evolve into the atmosphere where it is ignited and burned. The water serves primarily as a seal to prevent back mixing of air into the distribution manifold and pipeline and also protects the manifold from thermal radiation damage. In effect, the burn pond is thus a zero-height stack with a high-discharge area and a water seal. (TFD)

25595 (TID/SNA-831) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Aero/Thermo Analysis. Appendix A, Book 3 of 3 (Addendum 2, to Appendix A, F008-NAS01-W224). Margetts, M. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 356p. Dep. NTIS $21.00.

Work accomplished during the period from Oct. 1970 to May 1971 in defining the aerodynamic and heat transfer characteristics of the exhaust duct system (EDS) of the NERVA Altitude Simulation System (NASS) is described. Information from the scale model testing and design analysis of the turning plenum, on the secondary ejector, and on NASS/EDS system performance is included. (LCL)

25596 (TID/SNA-838) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design. PDR, F008-NAS01-W224. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 131p. Dep. NTIS $9.75.

One-hundred-fourteen "vu-graphs" containing information on the design requirements, performance criteria and methods for analyzing and correcting problems related to the exhaust duct system of the NERVA Altitude Simulation System are presented. (LCL)

25597 (TID/SNA-872) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Structural Analysis. Appendix B (Addendum 1 to Appendix B F008-NAS01-W224). Michaux, B. B. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 394p. Dep. NTIS $22.75.

The preliminary structural analyses of the Exhaust Duct System (EDS) components including those components affected by the modified water injection subsystem are presented. These analyses are presented as documentation of the completion of the EDS preliminary structural analysis. The analyses were performed in the critical areas to verify the structural adequacy of the proposed design. (auth)

25598 (TID/SNA-874) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Aero/Thermo Analysis. Appendix A. Book 2 of 3. (Addendum 2 to Appendix A F008-NAS01-W224). Margetts, M. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 228p. Dep. NTIS $14.50.

Further thermal analyses of the Oct. 1970 design of the primary ejector, turning plenum, and secondary ejector of the Exhaust Duct System of the NASS are presented. (LCL)

25599 (TID/SNA-915(Pt.1)) OPERATING MANUAL FOR 2750°C VACUUM/INERT INDUCTION FURNACE. Volume I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1972. 302p. Dep. NTIS $18.25.

The induction furnace was procured for the fabrication of the NERVA nozzle extension. This volume of the induction furnace operating manual contains information on furnace design, preliminary inspection, operating procedures, emergency procedures, trouble shooting, maintenance, spare parts and drawings. (LCL)

25600 (TID/SNA-915(Pt.2)) OPERATING MANUAL FOR 2750°C VACUUM/INERT INDUCTION FURNACE. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1972. 457p. Dep. NTIS $26.00.

Service manuals are presented for the following components of the induction furnace: vacuum system, argon system, cooling water system, power system, and gantry train. The induction furnace was procured for the fabrication of the NERVA Reactor nozzle extension. (LCL)

25601 (TID/SNA-915(Pt.3)) OPERATING MANUAL FOR 2750°C VACUUM/INERT INDUCTION FURNACE. Volume III. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1972. 659p. Dep. NTIS $36.00.

Service manuals for the temperature and power instrumentation, pressure instrumentation, and failsafe instrumentation for the induction furnace are presented. The induction furnace was procured for the fabrication of the NERVA nozzle extension. (LCL)

25602 (TID/SNA-962) ENGINEERING OPERATIONS REPORT: DESIGN AND DEVELOPMENT OF LH_2 COOLED ROLLING ELEMENT RADIAL BEARINGS FOR THE NERVA ENGINE TURBOPUMP. Volume III. Phase II. Tests on Build-ups 16, 17, and 18 at NRDS, Jackass Flats, Nevada, December 1971–March 1972. Accinelli, J. B.; Koch, D. A.; Reuter, F. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1972. 338p. Dep. NTIS $20.00.

LH_2 test results of the first three 65mm ball bearing build-ups tested in Test Cell "A", NRDS, Jackass Flats, Nevada, are presented. Each of the three build-ups completed more than 8.6 h of accumulated duration and the final build-up successfully achieved the 15-h target duration without bearing failure. These tests indicate a significant desirable effect on bearing life and performance of slight improvements in the bearing material, improvement in bearing retainer configuration and method of fabrication, tighter tester assembly fits, and better control of operating parameters. However, considerably more development testing needs to be done to clearly define the contributing parameters and their effect on bearing life and performance in this severe LH_2 environment. (auth)

25603 (TID/SNA-963) FLUID DYNAMICS COMPUTER PROGRAMS. (Aerojet-General Corp., Sacramento, Calif. (USA)). 9 May 1972. 322p. Dep. NTIS $19.25.

During the design of the NERVA Turbopump, numerous computer programs were developed for the analyses of fluid dynamic problems within the machine. The programs developed are: centrifugal flow pump sizing program; axial thrust balancer stability analysis; circular section volute design; inducer and impeller performance program; impeller discharge traverse data evaluation; pump air test data reduction; overall performance of a two stage LH_2 pump; crossover passage design; air pump performance map; pump axial thrust program; LH_2 pump test data reduction program; axial blade design program; and multistage axial flow turbine performance analysis program. This report contains program descriptions, example cases, user's instructions, and listings for the majority of these programs. In some cases only the listing is included. (auth)

25604 (TID/SNA-977) FEASIBILITY DEMONSTRATION OF A 90MM HYDROSTATIC RADIAL BEARING FOR A HYDROGEN TURBOPUMP APPLICATION. Phase II, November 1969–January 1970. Roesch, E.; Accinelli, J. B. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1970. 53p. Dep. NTIS $5.75.

A testing program to demonstrate the feasibility of a 90 mm-dia. liquid hydrogen journal bearing for turbopump application in the NERVA size pressure class is described. Five test runs were made on an improved test bearing. The actual load capacity during tests with LH_2 at 12,000 rpm and 700 psi ΔP was 1180 lbs at 0.6 eccentricity ratio. It was concluded that hydrostatic bearings for LH_2 and NERVA turbopump applications are feasible and further developed effort was recommended. (LCL)

25605 (TID/SNA-984) ENGINEERING OPERATIONS REPORT: N8610R:71-005 GIMBAL PIVOT ASSEMBLY DESIGN STUDY. Bronner, H. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1971. 70p. Dep. NTIS $6.50.

The gimbal pivot provides a load-carrying universal joint function with the degrees of freedom necessary for engine thrust vector control. Loads are transmitted from the lower thrust structure through the two pitch axis trunnions of the gimbal pivot to two flexure cores, from the cores through the cruciform to reacting flexure cores and trunnions on the yaw axis, then to the upper thrust structure. The analysis and design studies made for the gimbal pivot concept selected for the NERVA engine are presented. The goal of these studies was to delineate those material and construction choices which will optimize the gimbal pivot with respect to performance, size, and weight. The nuclear, thermal, stress, weight, and dynamic analyses made for the gimbal pivot assembly as a unit or as a part of the engine assembly are reviewed. Finally, fabrication methods are discussed briefly. (LCL)

25606 (TID/SNA-1015) NERVA PUMP COMPONENT DEVELOPMENT TESTING AT TEST CELL C. Kresny, H. S. (Aerojet-General Corp., Jackass Flats, Nev. (USA)). 21 Aug 1970. 32p. Dep. NTIS $4.75.

The Cryogenic Evaluation Laboratory (CEL) complex at Test Cell "C" at the NRTS was designated for NERVA LH_2 pump component testing. The CEL had been inoperative for 5 y and had been subjected to fire damage during Phoebus II tests. The existing facility was evaluated for the pump testing use and modifications required to support the pump test program were recommended. It was concluded that the pump test program could be carried out at Test Cell "C". (LCL)

25607 (TID/SNA-1016) STRUCTURAL EVALUATION OF ROTOR ASSEMBLY FOR PUMP PERFORMANCE TESTS. Harris, C. L. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 24 Mar 1970. 41p. Dep. NTIS $5.25.

Stress analyses performed to determine the critical speed and margin of safety of NERVA turbopump rotors are presented. These pumps will be used for future pump performance tests with LH_2. (LCL)

25608 (TID/SNA-1098) ENGINEERING OPERATIONS REPORT: CHILLDOWN STUDY OF THE SINGLE STAGE INDUCER TEST RIG. Kimura, L. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 2 Jun 1972. 29p. Dep. NTIS $4.50.

The objective of the pump chilldown test was to obtain data which could be used for improving the pump analytical model and to observe phenomena which could influence pump chilldown. The pump chilldown tests were conducted at NRDS (Nuclear Rocket Development Station) on a low priority basis in conjunction with the primary pump performance tests. These tests were performed in Test Cell "C" between December 8 and 22, 1971. (auth)

25609 (TID/SNA-1112) PROJECT REPORT: NON-NUCLEAR COMPONENT SPECIFICATIONS. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 May 1972. 11p. Dep. NTIS $4.00.

This task covered the preparation and maintenance of Sections 1, 2, 3 and 6 of all non-nuclear component specifications (excepting the engine purge unit) identified on Specification Tree SNPO-C-ST-1H. It also includes the Structural Support Valve, identified as part of the Nuclear Subsystem. Only Part I specifications (Design/Performance Requirements) were to be prepared. (TFD)

25610 (TID/SNA-1113) TEST PLAN FOR THE EVALUATION OF LH_2 COOLED 60 mm BALL BEARINGS AT 1.8×10^6 DN AND VARYING COMBINED LOADS (A SUPPLEMENT TO REPORT 774OR-69-0043 DATED 30 JUNE 1969). Accinelli, J. B. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 29p. Dep. NTIS $4.50.

The original report is amended to include a test development program using 60 mm ball bearings in a preloaded duplex mounting. Such a bearing set is capable of supporting radial loads with reasonable radial stiffness (about 2.0×10^6 lb/in.) without the attending problems of roller and galling associated with roller bearings at high DN values, or bearing radial clearances which can amplify bearing radial loads. The present addendum discusses the test program designed to demonstrate the load carrying capacity and life of a 60 mm duplex set, operating at 30,000 rpm (1.8×10^6 DN) with LH_2. The presently desired goal is for a radial load capacity of 1000 lb and a 10 h life at very high reliability (>.9999). At the desired conditions, fatigue failure of the bearing metal surfaces may be a significant factor in the reliability of this bearing system and the current program is designed to evaluate this problem. (auth)

25611 (TID/SNA-1118) STANDARD: CONOSEAL GROOVES AND FLANGES. Part II. Machining and Handling Require-

ments. (Aerojet-General Corp., Sacramento, Calif. (USA)). 11 Dec 1963. 174p. Dep. NTIS $11.75.

Single seal, double stepped, double opposed, and V band coupling grooves and flanges are covered. (DLC)

25612 (TID/SNA-1138) DESIGN AND DEVELOPMENT OF LH_2 COOLED ROLLING ELEMENT RADIAL BEARINGS FOR THE NERVA ENGINE TURBOPUMP. Phase I, January 1969–December 1971. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 568p. Dep. NTIS $31.50.

Data related to the development of liquid H_2-cooled radial bearings for the NERVA engine turbopump are presented and include: computer printout data on bearing configurations, loading, displacement, velocity, etc; performance test data for 65 mm and 60 mm ball bearings; plans for testing 65 mm roller bearings; and future bearing reliability and critical speed tests. (LCL)

25613 (TID/SNA-1142) FEASIBILITY DEMONSTRATION OF A 90 MM LH_2 HYDROSTATIC RADIAL BEARING FOR TURBOPUMP APPLICATION. Summary Report, December 1968–November 1969. Roesch, E.; Accinelli, J. B. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 45p. Dep. NTIS $5.25.

Progress in demonstrating the feasibility of a 90 mm liquid H_2 hydrostatic bearing for NERVA turbopump application is reported. Information is included on: test bearing analysis and design; test equipment, and procedures; and test results. Bearing design modifications and test equipment modifications are recommended. (LCL)

25614 (TID/SNA-1151) DEVELOPMENT TEST PROCEDURE FOR OBTAINING STRESS AND DEFLECTION DATA ON AEROQUIP CORP. V-BAND COUPLINGS AND FLANGES. Hartwig, R. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 14 Oct 1970. 76p. Dep. NTIS $7.00.

Procedures for testing Aeroquip Corp. V-Band Coupling Flange/Conoseal gasket combinations to obtain stress and deflection data are described. Procedures for both steel and aluminium flanges are included. Stresses and deflections due to coupling bolt pretorgue, external axial tension and bending moment loads, torsion loads, and internal pressure are considered. (LCL)

25615 (TID/SNA-1298) LH_2 PUMP TEST RIG STRUCTURAL ANALYSIS. Appendix I. Nevenzel, J.; Mironenko, G.; Rock, A. O. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1971. 211p. Dep. NTIS $13.75.

This appendix covers housings, labyrinth seals, rear bearing cartridge, drive coupling, rotating parts, and test rig support. (DLC)

25616 (TID/SNM-17) ENGINE TEST STAND-1 FACILITY REQUIREMENTS. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 4 Apr 1969. 35p. Dep. NTIS $4.75.

The integrated facility requirements for testing the NERVA engine are described, and form the basis for preparation of the ETS-1 Design Criteria, Data Item F007-CP-090219. The facility, designated as Engine Test Stand 1 (ETS-1), shall consist of Test Support Systems, NERVA Altitude Simulation System (NASS), Instrumentation and Control (I&C), Structures, Buildings, Utilities and Site Work. ETS-1 will be used for the testing of the NERVA engine during the major amount of development and preliminary qualification phases. (auth)

25617 (UCRL-51695) ANALYSIS AND DESIGN OF A PYROTECHNIC-POWERED SELF-STOPPING ACTUATOR. Kopytoff, V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jan 1975. Contract W-7405-eng-48. 144p. Dep. NTIS $10.25.

Thesis.

Safety and environment considerations necessitate the use of automatic emergency shut-off valves in nuclear power-plants, underground nuclear tests, oil pipelines, and even oil wells. Such valves require actuators to move a member (e.g., a gate, a stem or a ball which may weigh hundreds of pounds) in a time that may be as short as a fraction of a second, and which must have some provision for decelerating the moving body at the end of its stroke to avoid a damaging impact. A device for satisfying these requirements with the high reliability required for such systems is proposed. This device consists of a double-acting piston driven by gas generated by the combustion of a propellant, with the novel feature of using a precisely determined straight hole through the piston to provide a gas cushion for deceleration during the last part of the stroke. Predicting the performance of such an actuator required analysis and calculation of the rate of propellant gas generation, the rate of gas flow into the actuator cylinder, and that of gas flow through the piston hole. Because of the complexity of this analysis, a numerical solution was required. A computer subroutine for carrying out this solution was developed. Its applicability was verified by comparison of the predicted and experimentally measured performance of a specific actuator. A complete program using this subroutine was then written for designing an actuator. This program incorporates a procedure which simultaneously satisfies seven design requirements by minimizing the sum of squares of the differences between calculated and required values of these requirements. The program is interactive with the user, communicating with him to report the progress of the design and to obtain design decisions during execution. Designs produced by the program were found to be efficient and consistent. No knowledge of thermodynamics or of the pyrotechnic gas generator process is required of the user. (auth)

25618 (WANL-TME-261) REVIEW OF E-MAD DRAWINGS RECEIVED PRIOR TO JANUARY 29, 1963. Svasek, A. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 31 Jan 1963. 6p. Dep. NTIS $4.00.

Comments and questions related to the design of the Engine Maintenance, Assembly/Disassembly Facility (E-MAD) for the NERVA program are presented. (LCL)

25619 (WANL-TME-500) BIBLIOGRAPHY ON LUBRICATION IN VACUUM-SPACE ENVIRONMENT. Raimondi, A. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Jul 1963. 51p. Dep. NTIS $5.75.

Data obtained in lubrication experiments conducted in vacuum or simulated space environment are compiled. This information should aid designers in selecting lubricant materials and mechanisms for space vehicles. (LCL)

25620 (WANL-TME-667) THREAD GALLING TESTS USING SIMULATED NRX-A FASTENERS AND ENVIRONMENTS. Kallin, I. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1964. 37p. (EE–3493). Dep. NTIS $5.00.

A series of tests were run to develop threaded fasteners of titanium and other NRX-A materials, capable of operating at –320°F and 500°F in hydrogen under very high tightening loads without galling. A very satisfactory process was found for plating titanium fasteners with silver although this was previously believed to be quite difficult. This process is also applicable to alloy steels and other metals. A process for obtaining a thin hard coating on titanium alloys by "tuftriding" was also found. All the silver plated parts and "tuftrided" parts performed well, while untreated parts and those with other chemical coatings galled severely at high loads. Coating either the bolt or its mating nut is satisfactory although coating the bolt gives longer wear life. (auth)

25621 (WANL-TME-925) MOCK-UP WATER LOOP INSTALLATION AT WANL. Newby, D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Jan 1964. 7p. Dep. NTIS $4.00.

The Mock-Up Water Test Loop provides a facility for the nonnuclear testing of samples under the same pre-irradiation environmental conditions which exist in the W-2 Water Loop at the Plum Brook Reactor. Preliminary testing is necessary to insure that the sample items to be irradiated will withstand the nonnuclear portion of the environment. The design and operation of the Mock-Up Loop are described. (LCL)

25622 (WANL-TME-1603) EVALUATION OF WET DUCT SYSTEM FOR E/STS 2-3 TEST STANDS. Gilchrist, M. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1967. 80p. Dep. NTIS $7.00.

The results of water evaporative cooling of hydrogen in a 1/60 scale model of a duct to be erected for the test stand E/STS 2-3, at NRDS are reported. During this same interim, AGC obtained data on a $1/_{20}$ scale model. Results of this program made it possible to develop a method for predicting the distance required to cool hydrogen from 4500 to 1650°R on the full scale duct by combining the WANL $1/_{60}$ scale information with the $1/_{20}$ scale AGC data. (auth)

25623 (WANL-TME-1996) TEST CELL C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1970. 80p. Dep. NTIS $7.00.

The facility requirements for Test Cell "C" for testing the NERVA engine are documented. (LCL)

25624 (WAPD-TM-1140) BESTRAN: A TECHNIQUE FOR PERFORMING STRUCTURAL ANALYSES. Friedrich, C. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Bettis Atomic Power Div.). Feb 1975. Contract AT(36-1)-GEN-14. 79p. Dep. NTIS $7.00.

Two fundamental solution techniques for performing stress analysis of structural components are discussed. The KADEL

technique combines finite elements to form the resulting stiffness matrix of a structure. The NODE technique connects finite elements at key nodal points in a structure. These solution techniques are applied to a typical problem in structural analysis. (auth)

25625 PROCESS AND DEVICE FOR THE THERMAL INSULATION OF A PIPE. Peuchmaur, A. (to Societe pour l'Industrie Atomique). French Patent 2,170,328. 31 Jan 1972. 14p. (In French).

The device, according to the invention, comprises a cylindrical ring of ceramic material with a low thermal expansion coefficient, a high compression yield limit and a low thermal conduction coefficient and resilient blocks distributed on the ring periphery and forming at least one full turn, each of said resilient blocks being tightly applied against the ring outer wall by means of a removable clamping member which crosses the ring radially, and the fluid flowing along the ring inner cavity. (FR)

25626 APPROXIMATE MODEL FOR AN ELASTIC-PLASTIC PIPE ELEMENT UNDER COMBINED LOADING. Larson, L. D.; Stokey, W. F.; Franzen, W. E. Paper No. 74-WA/PVP-4. New York; American Society of Mechanical Engineers (1974). 7p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

An approximate model for the elastic-plastic analysis of a pipe element under combined loading is developed. The model is obtained by generalizing a limit load solution for combined pressure, bending, torsion and axial load to include strain hardening. For various combinations of loading of tubes, curvatures and twist angles are predicted and compared with experimental results and those predicted by a more rigorous analytical approach. The comparison shows that good results are obtained from the approximate model. (auth)

25627 QUICK REPLACEMENT SYSTEM FOR VALVES. Martin, E. (Mainz Univ. (F. R. Germany). Inst. fuer Kernphysik). Kerntechnik; 16: No. 11, 499-500(Nov 1974). (In German, English).

The stay of people in radioactive surroundings must be restricted to the shortest possible time or be entirely avoided. This means that maintenance times must be reduced by efficiently operating replacement systems. The quick replacement system described solves this problem most satisfactorily. It operates manually or automatically and its main feature is a completely trouble-free design. The basic system presented (for valves and similar components) can be extended to larger dimensions. (auth)

25628 HYDRODYNAMIC STABILITY AND THERMAL PERFORMANCE TEST OF A 1-MWt SODIUM-HEATED ONCE-THROUGH STEAM GENERATOR MODEL. Waszink, R. P.; Efferding, L. E. (Westinghouse Electric Corp., Tampa, FL). J. Eng. Power; 96: No. 3, 189-200(Jul 1974).

The 1-MWt Heat Transfer Model (HTM-1) test program was directed to the development of techniques to predict, and thereby avoid, water-side instabilities in sodium-heated once-through and recirculating steam generators. Water-side performance instabilities in steam generators have been an underlying problem through decades of experience. This subject is of particular concern to sodium-heated units due to the severe performance deterioration that can result from such instability. The 1-WMt test model contains nine 0.50 in. OD 130 ft long serpentine tubes. Thermocouples and low-pressure-drop orifice flow meters were installed at the feedwater inlet end of each of the three active tubes to disclose instabilities. These measurements were recorded on a high-speed oscillograph. Instabilities were deliberately induced in order to determine the inception condition of instability. The model was dynamically stable for a range of operating conditions. The model was statically stable (uniform static feedwater flow distribution) at all steam outlet conditions tested. The model was generally more stable than predicted especially at higher loads. (auth)

Lasers

Refer also to abstracts 25451 and 25960.

25629 (AD-777751) LASER SPECTROSCOPY. Proceedings of An International Conference, Vail, Colorado, June 25-29, 1973. Brewer, R. G.; Mooradian, A. (eds.). (International Business Machines Corp., San Jose, Calif. (USA). Research Lab.; Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 28 Feb 1974. 655p. (CONF-730658-; AFOSR-TR-74-0478). NTIS.

A separate abstract was prepared for eight of the forty-five papers presented at the conference. The remaining papers are not in scope for NSA. (TFD)

For abstracts of individual papers see: 25630-25637.

25630 (AD-777751, pp 118-126) TUNABLE INFRARED COHERENT SOURCE FOR THE 2 TO 25 MICRON REGION AND BEYOND. Wynne, J. J.; Sorokin, P. P.; Lankard, J. R. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). 28 Feb 1974.

From conference on laser spectroscopy; Vail, Colorado, USA (25 Jun 1973).

In Laser spectroscopy.

A novel method of generating coherent, widely tunable infrared radiation is described. The method uses a four-wave parametric mixing process in alkali metal vapors. The tuning range presently spans the 2 to 25 micron region. The possibilities of extending the tuning range are discussed. (auth)

25631 (AD-777751, pp 233-248) HIGH RESOLUTION TUNABLE INFRARED LASERS. Mooradian, A. (Massachusetts Inst. of Tech., Lexington). 28 Feb 1974.

From conference on laser spectroscopy; Vail, Colorado, USA (25 Jun 1973).

In Laser spectroscopy.

Some recent developments in the technology of tunable sources which operate in the near to middle infrared regions are presented. Included among these are external cavity controlled and hydrostatic pressure tuned semiconductor lasers, spin-flip Raman lasers, and nonlinear mixing using tunable and quasitunable laser sources. The spectral linewidth and tuning range of these devices will be discussed with emphasis on their application for high resolution spectroscopy. (auth)

25632 (AD-777751, pp 249-259) ADVANCES IN TUNABLE LEAD-SALT SEMICONDUCTOR LASERS. Melngailis, I. (Massachusetts Inst. of Tech., Lexington). 28 Feb 1974.

From conference on laser spectroscopy; Vail, Colorado, USA (25 Jun 1973).

In laser spectroscopy.

As a result of recent progress in the materials and device technology of tunable lead-salt diode lasers, including the use of stripe geometry and heterostructures, cw output powers as high as 1/3 mW have been obtained and cw operation has been observed at temperatures considerably higher than previously. In addition to their already demonstrated capabilities in ultrahigh resolution molecular absorption spectroscopy, the high-power capability should extend the use of these lasers to additional applications including saturation spectroscopy, heterodyne radiometry and high sensitivity absorption measurements with the spectrophone technique. (auth)

25633 (AD-777751, pp 260-279) HIGH PRESSURE WAVEGUIDE GAS LASERS. Smith, P. W. (Bell Telephone Labs., Inc., Holmdel, NJ). 28 Feb 1974.

From conference on laser spectroscopy; Vail, Colorado, USA (25 Jun 1973).

In Laser spectroscopy.

Waveguide gas Lasers are lasers within which the light is guided by a hollow dielectric waveguide which also serves to confine the discharge. Because these lasers operate at high gas pressures and thus have relatively broad oscillation bandwidths, they are of interest as potential sources for laser spectroscopy. The design and operating parameters of this type of laser are discussed. (TFD)

25634 (AD-777751, pp 280-289) WIDEBAND WAVEGUIDE CO_2 LASERS. Abrams, R. L. (Hughes Research Labs., Malibu, CA). 28 Feb 1974.

From conference on laser spectroscopy; Vail, Colorado, USA (25 Jun 1973).

In Laser spectroscopy.

Operating characteristics of sealed-off waveguide CO_2 lasers as the discharge diameter is decreased with a corresponding increase in operating pressure are reviewed. Gain, output power, and efficiency data are presented for several waveguide CO_2 laser devices. (TFD)

25635 (AD-777751, pp 290-300) FREQUENCY STABILIZATION OF A CW DYE LASER. Barger, R. L. (National Bureau of Standards, Boulder, CO). 28 Feb 1974.

From conference on laser spectroscopy; Vail, Colorado, USA (25 Jun 1973).

In Laser spectroscopy.

Dye lasers that use a quartz-window dye cell are described. Single-mode operation was obtained by using two intracavity Brewster-angle prisms, two uncoated solid etalons with optical

thicknesses of 3 and 19 mm, and a mode-limiting aperture. It was also found that using a very short focal length (R = 1 cm) high-reflectivity mirror next to the Brewster-angle dye cell greatly improved the stability of the single-mode operation, perhaps owing the spatial saturation effects in the dye cell (1 mm thick). By simultaneously tilting both etalons and displacing the flat output mirror, continuous tuning of the single mode could be accomplished over intervals of 1.5 GHz. Typical single-mode output power was 5 mW (with 1 W argon pump power) with approximately 10% amplitude noise (0 to ~ 100kHz). Continuous free-running operation in a given longitudinal (c/2L 120 MHz) mode was limited to about 1 min. (TFD)

25636 (AD-777751, pp 510-518) FAR INFRARED GENERATION. Lax, B.; Aggarwal, R. L. (Massachusetts Inst. of Tech., Cambridge). 28 Feb 1974.

From conference on laser spectroscopy; Vail, Colorado, USA (25 Jun 1973).

In Laser spectroscopy.

One of the exciting challenges in recent years has been the development of a coherent radiation source that would bridge the energy region between the infrared and the microwaves. A system that achieves this objective, consisting of two high-power CO_2 TEA lasers and a non-collinear phase matching technique in a crystal of GaAs, is described. (TFD)

25637 (AD-777751, pp 519-527) TUNABLE FAR-INFRARED GENERATION BY DIFFERENCE-FREQUENCY MIXING IN INDIUM ANTIMONIDE. Nguyen, V. T.; Bridges, T. J. (Bell Telephone Labs., Inc., Holmdel, NJ). 28 Feb 1974.

From conference on laser spectroscopy; Vail, Colorado, USA (25 Jun 1973).

In Laser spectroscopy.

A strong resonant optical nonlinearity due to the conduction electron spins has been observed when the frequency (~100 cm^{-1}) of far-infrared (FIR), generated by difference frequency mixing of two orthogonally polarized CO_2 laser beams in tuned to the spin-resonance frequency in InSb. This effect allows us to take full advantage of the availability of the tunable radiation from the spin-flip Raman laser (SFR) in the generation of tunable FIR from 90 cm^{-1} to 100 cm^{-1}. A successful attempt to solve the problem of "jump tuning" of FIR due to the presence of longitudinal cavity modes of SFR laser by replacing it with a nonresonant superradiant spin-flip Raman laser (NRSSFR) is also discussed. (auth)

25638 (AD-778383) INVESTIGATION OF PULSE SUPERRADIANT RADIATION OF THALLIUM VAPORS. Abrosimov, G. V.; Andreev, N. G.; Odintsov, A. I. Translated from Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; No. 3, 287-291(1973). 9p. (NISC-TRANS-3522). NTIS $4.00.

The relationship between the power of pulse superradiant radiation of line 5350 Å of a thallium vapor laser and the parameters of the discharge was experimentally investigated; and the optimum conditions of superradiant radiation excitation were determined. The unidirectional superradiant radiation discharge mode was observed. It was found by means of a Fabry-Perot interferometer that the line consists of three components caused by isotopic and hyperfine structure splitting. Each of the components reveals a specific structure characteristic of lasers of a given type. The results obtained are critiqued. (GRA)

25639 (AD-780178) H_2-Cl_2 CHEMICAL LASER PROGRAM. Part I. CHEMLUM Code for Spectroscopic Data Analysis. Final Report, December 1972-December 1973. Latimore, J. T.; Takemoto, A. M.; Ackerman, R. A.; Shackleford, W. L.; Emanuel, G. (TRW Systems Group, Redondo Beach, Calif. (USA)). Jan 1974. Contract DAAH01-73-C-0446. 51p. (RK-CR-74-9-PT-1). NTIS $3.75.

A new computer code is described that analyzes data obtained from spectroscopic measurements of chemiluminescent emission. Primary input to the code is digitized spectrometer signal data of the vibrational-rotational emission spectra of HCL, HF or DF molecules. The code computes the rotational temperature, vibrational number densities, and line-by-line gains of the excited species. This report presents the theoretical basis and numerical formulation for the code, and operational procedures for its use. A sample case is included. (auth)

25640 (AD-782219) UV GAS LASER INVESTIGATIONS. Semiannual Technical Report. Bhaumik, M. L.; Ault, E. R.; Olson, N. T. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). May 1974. Contract N00014072-C-0456. 31p. (NRTC-74-26R). NTIS $3.25.

A peak laser power of 0.5 mW with an estimated efficiency of 0.2% has been obtained at 3577Å from a mixture of 92 psia Ar and 8 psia N_2 which was excited by an e-beam of 400A/cm squared at 1.3 MeV in a 20 ns pulse. A saturation intensity of about 100 kW/cm^2 was deduced and a beam divergence of 10 milliradian was measured from the laser having a 10 cm gain length. (auth)

25641 (AD-783322) CARBON MONOXIDE LASER: A REVIEW. Chen, C. C. (Rand Corp., Santa Monica, Calif. (USA)). Jan 1974. 47p. (P-5163). NTIS $3.25.

A review of the CO laser is presented. First, a brief review of the general operational characteristics of a CO laser and the principle of partial inversion is given. Then the principle of anharmonic (V-V) pumping is presented. A state-of-the-art review of the various types of cw CO lasers is presented together with the excitation and inversion mechanisms of these CO lasers. These include the following: the electric CO laser, the $CO-N_2$ flow laser, the CO, GDL (gas dynamic laser), and the chemical CO laser. Finally, a recently proposed CO GDL pumped by an electron-beam ionizer-sustainer discharge system is described. This new laser system could have both the high efficiency of an electrically pumped CO GDL and the high power of a thermally pumped CO GDL because of the unique operational requirements of the CO laser. (GRA)

25642 (AD-784589) ANALYTICAL INVESTIGATION OF THE EFFECTS OF ROTATIONAL RELAXATION IN A C. W., HF CHEMICAL LASER. Chao, C. M.; Skifstad, J. G. (Purdue Univ., Lafayette, Ind. (USA)). 14 Jun 1974. Contract DAAH01-73-C-0167. 36p. (RK-CR-74-11). NTIS $3.25.

Rotational relaxation effects in a cw chemical laser amplifier or a line-selected oscillator are examined in terms of a simple analytical model. Three rotational levels in each vibrational level of the lasing transition are taken to have finite rotational relaxation rates. The results indicate the effects are likely to be significant, lowering the available power and leading to an optimum level of the line intensity for maximum power output, apart from consideration of optical losses at mirrors, windows, etc. while the model accounts for ΔJ = plus or minus 1 transitions only. The collisional transition probability was augumented in the computations in an attempt to provide high estimates for the rotational relaxation rates, including factors such as $\Delta J > 1$ transitions. (auth)

25643 (AD-784590) ANALYTICAL AND EXPERIMENTAL RESEARCH ON HF CHEMICAL LASERS. Annual Report, 26 September 1973-30 June 1974. Skifstad, J. G. (Purdue Univ., Lafayette, Ind. (USA)). 14 Jun 1974. Contract DAAH01-73-C-0167. 9p. (RK-CR-74-12). NTIS $3.00.

The report summarizes the research activity on HF lasers. Analytical results for rotational relaxation indicated significant compromises in the performance of line selected oscillators or amplifier (MOPA) configurations with HF as contrasted with Boltzmann populations of the rotational levels. An experimental program was initiated to obtain measurements in HF/DF flow systems pertinent to chemical laser devices. The initial efforts have been concerned with development of an electrically excited HF laser for cw optical studies and the design of a low density flow facility for the research. (auth)

25644 (AD-785596) PRODUCTION ENGINEERING MEASURE FOR OPTICAL PUMPS FOR LASERS. Quarterly Report No. 2, October-December 1973. Sowers, H.; Maynard, R. (ILC Technology, Inc., Sunnyvale, Calif. (USA)). 1 Feb 1974. Contract DAAB05-73-C-2078. 29p. (R-ILC-73-22/02). NTIS $3.75.

This program is directed towards establishing a capability for the manufacture of flashlamps to be used as optical pumps in laser systems. Work has been directed towards the evaluation and establishment of a series of lamps to be used as secondary standards throughout the program. A matrix of probably near-optimal variations covering the design of compressed gas cooled lamps with a 2.050 in. arc length was developed and first samples fabricated. The evaluation of liquid cooled lamps has continued. The government furnished property was received and is being tested. Modifications have been completed to the special test equipment supplied by ILC, which includes a precision power supply, water cooled laser and fluorescent analysis instrument, and four channel data acquisition system. (auth)

25645 (AD-785669) 20 PPS HOLMIUM: YTTRIUM LITHIUM FLUORIDE LASER TRANSMITTER. Rosati, V. J. (Army Electronics Command, Fort Monmouth, N. J. (USA)). 1974. 16p. NTIS $3.25.

Holmium-doped yttrium lithium fluoride (Ho:YLF), emitting at 2.06 micrometers, is a promising material for laser target designators. The design and construction of a 20 pps 2 micrometer designator transmitter is presented. In the following, the systems specifications of the 1.06 micrometer lightweight designator, presently undergoing engineering development, are accepted as the relevant baseline for a 2 micrometer device. The salient

features of the 1.06 micrometer device are: 100 mJ output, 20 ns pulse length, 10 to 20 pps, 0.2 mrad beam divergence, and 12 lb. total weight. (GRA)

25646 (AD-785911) INVESTIGATION OF HIGH POWER MHD GAS LASERS. Semiannual Report, January–August 1974. Zauderer, B.; Tate, E.; Marston, C. H. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). Aug 1974. Contract N00014-74-C-0243. 31p. NTIS $3.75.

Results obtained during the first half of 1974 in the study of MHD-powered gas lasers are presented. Key results of the work thus far are: changes to the shock tunnel and test facility include a modified cesium seed injection system, relocation of the secondary diaphragm, installation of a primary double diaphragm and a new CO_2 probe laser. Gain measurements previously reported have been repeated, with substantial improvement in the signal attributable to the above changes. Achievement of 19% enthalpy extraction in the MHD generator channel is an important step forward in generator performance. (auth)

25647 (AD-786675) OPTICAL PUMPS FOR HOLMIUM LASERS. Final Report, 1 Jul 1972–30 Jun 1973. Noble, L.; Reed, L.; Maynard, R.; Flentz, H. (ILC Technology, Inc., Sunnyvale, Calif. (USA)). Jul 1974. Contract DAAB07-72-C-0274. 80p. (R-ILC-73-7/F). NTIS $4.75.

The objective of this program was to increase the efficiency of optical pumps for low-energy holmium lasers. The characteristics of the final lamps, modulator circuitry and cavity are given. Also are recommendations for future lamps, cavity and modulator, based upon data taken during this program. Efficiency improvements were achieved by optimizing the bore diameter, fill pressure, gas composition, envelope wall material, pulse length and starting method. Active filters, Ho:YLF materials of differing composition, and various cavity configurations were also investigated. (GRA)

25648 (AD-786679) FABRICATION OF BaF_2 INFRARED WINDOWS. Final Technical Report, 1 Dec 73–31 Aug 74. Austin, A. E.; Mueller, J. J.; Miller, J. F.; Borg, K. C. (Battelle Columbus Labs., Ohio (USA)). 30 Sep 1974. Contract DAAH01-74-C-0358. 68p. (RK-CR-75-11). NTIS $4.25.

The feasibility of the fabrication of polycrystalline BaF_2 windows for infrared lasers by the hot isostatic pressing process (HIP) was investigated. A method of treatment with HF gas for the preparation and surface cleanup of the BaF_2 powder was developed. The HIP conditions for densification, sintering and grain growth of BaF_2 bodies were determined. Light transmission through the BaF_2 windows was found to be limited by scattering by intergranular gaseous pores or intragranular voids. The HIP process by the present techniques amenable for the fabrication of windows for use with high power infrared lasers. (auth)

25649 (AD-786738) INVESTIGATION OF THE FEASIBILITY OF THE ELECTRON BEAM-EXCITED, HIGH PRESSURE RECOMBINATION LASER. Special Technical Report. Collins, C. B.; Cunningham, A. J. (Texas Univ., Dallas (USA)). 1 Aug 1974. Contract N00015-67-A-0310-0007. 79p. (UTDP-ML-01). NTIS $4.75.

The first nitrogen ion laser pumped by charge transfer from He_2 (+) is reported. Intense laser emission in the violet at 427 nm was observed and found to have a linewidth less than 0.3 nm. The pumping ion, He_2 (+), was produced by discharge of a fast-pulsed electron beam gun into 7 atmospheres of a mixture of helium and nitrogen. Excitation current densities were 1.4 kA/cm^2 at 1 MV over a 1 × 10 cm transverse geometry. Under these conditions, the efficiency of the emission of 427 nm laser radiation was found to be 1.8% relative to the energy lost by the electron beam in the radiating volume. (auth)

25650 (AD-787143) EXPERIMENTAL CHEMICAL LASER MODE CONTROL. Final Technical Report, 16 March–15 August 1974. Rensch, D. B. (Hughes Research Labs., Malibu, Calif. (USA)). Oct 1974. 76p. NTIS $4.75.

An experimental study was performed on integer and integer plus one-half valued equivalent Fresnel number positive branch confocal unstable resonators in a DF-CO_2 flash-photolysis chemical laser. Near diffraction limited beam quality was obtained for a range of geometric output couplings from 30 to 77%. No dependence of beam quality on the resonator Fresnel number was found. This was true for uniform medium conditions as well as perturbed conditions where significant phase perturbation were introduced into the optical resonator. Extensive medium diagnostics were performed on the DF-CO_2 laser and the results presented. (auth)

25651 (AD-787337) CALCULATING THE TEMPERATURE FIELD OF MOLECULAR LASERS WITH GAS PUMPING. Orlov, L. N. Translated from Zh. Prikl. Spektrosk.; 16: No. 3, 437-442 (Mar 1972). 24p. (FTD-HC-23-1495-74). NTIS $3.25.

Significant successes have been achieved in developing molecular optical quantum generators by using continuously pumped gas through an active element–a discharge tube. The temperature of the gas is one of the most essential parameters in determining the efficiency and generation capacity. It is of interest to investigate the influence of gas pumping on the magnitude of heat evolution and the temperature distribution of the gas in the discharge tube of a molecular laser. For this purpose it is necessary to solve the problem of heat exchange with steady-state gas flow in a round tube with a given distribution of internal heat sources and limiting conditions of the first type. The investigation is limited to an examination of the laminar flow of a gas in a smooth cylindrical tube. (GRA)

25652 (AD-787436) AN EXPERIMENTAL INVESTIGATION OF SHORT DIFFUSERS FOR GAS DYNAMIC LASERS. Zerr, J. J. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1974. 52p. NTIS $4.25.

Thesis.

One of the largest components of a gas dynamic laser is the diffuser. A significant reduction in the size of this component could represent a significant savings in the size and weight of the entire system. The purpose of this investigation was to examine several short supersonic diffuser designs with fixed walls and no boundary layer control. Thick diffusers with shallow ramp angles are supposed to provide optimum pressure recovery for fixed diffusers. It was found in this investigation, however, that no loss of pressure recovery is suffered when steep ramp angles and thin diffusers are used. Steep ramps and thin diffuser sections would serve to minimize both the length and weight of supersonic diffusers. Start-up times were also investigated. (auth)

25653 (AD-787613) DEVELOPMENT OF A MINIATURIZED DYE LASER. Interim Report No. 2, 10 August–October 1974, see also report dated 8 August 1974, AD–784930. Glenn, W. H. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 7 Oct 1974. 17p. (UARL-N–921952-2). NTIS $3.25.

The objective of this program is to develop a miniaturized dye laser suitable for a variety of applications, particularly in an underwater environment. The following tasks have been performed: Re-evaluate alternative pumps cavity configurations; perform preliminary tests of promising new coumarin dyes; investigate the use of increased flashlamp input energy; evaluate the use of reduced arc length and of arc image defocussing to reduce pulse amplitude fluctuations; redesign the laser resonator for improved efficiency; investigate the effects of dye filtering and increased dye flow rates; demonstrate laser operation with 100 W usable peak power output, at a pulse repetition rate of at least 200 pps, for a non-stop operating period in excess of 20 s. This interim report presents a summary of the results of these investigations, followed by a brief outline of plans for continuing work in the next reporting period. (GRA)

25654 (AD-787625) TOWARDS SHORTER WAVELENGTH LASERS AND BREAKING THE 1000 ANGSTROM BARRIER II (BOUND-CONTINUUM EMISSION). Interim Report. Ali, A. W. (Naval Research Lab., Washington, D. C. (USA)). Aug 1974. 28p. (NRL-MR-2863). NTIS $3.75.

Bound-continuum lasers in the vacuum ultraviolet are discussed and criteria are developed for their realization. Furthermore, the possibility of a new cw laser in the vacuum ultraviolet (1550Å) from H_2, HD and D_2 was investigated. It is pointed out that in a two-temperature, continuously operating discharge, this laser is highly feasible. (GRA)

25655 (AD-787626) ARPA/NRL X-RAY LASER PROGRAM. Semiannual Technical Report to Defense Advanced Research Projects Agency, 1 Jan 1974–30 Jun 1974. Andrews, R. A.; Elton, R. C.; Beintjes, J.; Eckardt, R. C.; Lehmberg, R. H. (Naval Research Lab., Washington, D. C. (USA)). Oct 1974. 142p. (NRL-MR-2910). NTIS $5.75.

The ARPA/NRL x-ray laser program is concerned with demonstrating gain in the soft x-ray region. The program is jointly supported by ARPA and NRL. The approaches include electron-collisional pumping in picosecond laser pumped plasma, resonant charge transfer pumping, optical parametric mixing to short wavelengths, traveling wave e-beam pumping, and analysis and numerical modeling. This report covers the progress made during the second half of fy-74. (auth)

25656 (AD–787780) ADVANCED TECHNIQUES FOR IMPROVING LASER OPTICAL SURFACES. Semiannual Report No. 2, 1 Jan 1974–30 Jun 1974. Willingham, C. B. (Raytheon Co., Waltham, Mass. (USA). Research Div.). Sep 1974. 73p. (AFCRL-TR–74-0384). NTIS $4.25.

This program is a study of surface-finishing techniques considered to be capable of improving the surface quality of laser optical materials. A variety of conventional and superpolishing techniques will be developed for single-crystal and polycrystalline potassium chloride and calcium fluoride, and crystalline zinc selenide. Acceptable conventional polishing techniques for polycrystalline calcium fluoride and zinc selenide were developed, and preliminary grinding steps of the process were identified as requiring further study. Bowl-feed "superpolishing" was shown to improve the surface quality of conventionally polished zinc selenide and calcium fluoride substantially. Zinc sulfide powders were evaluated as infrared-transparent abrasives for potassium chloride and found to be inferior to alumina. Light scattering measurements demonstrated that ion milling could be used to clean surfaces prior to deposition of optical coatings without seriously degrading them, but that more extensive material removal sharply increased scattering at angles close to the specular direction. (auth)

25657 (COO-2007-56) ENHANCED OUTPUT FROM He Ne LASER BY NUCLEAR PREIONIZATION. DeYoung, R. J.; Wells, W. E.; Miley, G. H. (Illinois Univ., Urbana (USA)). [nd]. 4p. (CONF-741211-2). Dep. NTIS $4.00.

From international meeting on electron devices; Washington, District of Columbia, USA (9 Dec 1974).

It was demonstrated that heavy-ion bombardment of an electrically pulsed He-Ne laser, operating on the 1.15-μ and 3.39-μ transitions in neon, can produce substantial increases in laser output. Previous authors have shown that enhanced output from CO_2 lasers is also possible. In both cases high-energy charged particles were produced by neutron bombardment of a surface coating of boron-10 or by neutron reactions with ^3He gas. These charged particles then slow down in the gas mixture, depositing energy in the lasing gas. As a result, significant increases in laser output are observed compared to operation with electrical pumping alone, even though the nuclear energy input is a small fraction of the total. These results have important implications relative to the goal of direct nuclear pumping of gas lasers and subsequently the development of efficient, high-powered laser systems. (auth)

25658 (JPRS-62679) LASERS AND THEIR APPLICATION. Baranov, V. Yu.; Belokon, M. V.; Rubinov, A. N.; Yevdokimov, S. V.; Kadymov, A. Kh. Translated from Prib. Tekh. Eksp.; No. 5, 188-199(1973). 21p. NTIS $3.00.

Topics discussed include: high-pressure cathode preionization pulse CO_2 laser; organic dye accessory inverter for LGI-21 serial nitrogen laser; application of lasers for high-speed photography of fast processes; and Fabry-Perot laser interferometer for measuring plasma density in unsteady flow. (GRA)

25659 (UCRL-51728) COLD-CATHODE, ELECTRON-BEAM-SUSTAINED CO_2 AMPLIFIER GAIN STUDIES. Manes, K.; Eddleman, H.; Lindquist, W.; Glaros, S.; Smith, D.; Loda, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jan 1975. Contract W-7405-Eng-48. 22p. Dep. NTIS $4.00.

Measurements of small-signal gain coefficients have been made on electron-beam-sustained CO_2 laser amplifiers, having clear apertures of 11 × 11 cm and operated at 1520 torr. Gain uniformity over the full aperture, gain as a function of E/p, gas mixture, and rotational line have been investigated. (auth)

25660 DETERMINATION OF LASER PARAMETERS FROM SATURATED-GAIN MEASUREMENTS FOR A PARTIALLY HOMOGENEOUSLY BROADENED GAS-LASER AMPLIFIER. Gamo, H.; Ostrem, J. S. (Univ. of California, Irvine). J. Opt. Soc. Amer.; 65: No. 1, 29-32(Jan 1975).

The saturation irradiance and line-shape parameters of a high-gain laser transition were determined by analyzing the measured gain of a gas-laser amplifier as a function of incident radiation, based on a quadratic approximation to the saturated gain. Experimental results for a high-gain xenon 3.5 μm ($5d_{33} - 6p_{22}$) laser amplifier are presented. (auth)

25661 GaAs LASER DIODE PUMPED Nd: YAG LASER. Conant, L. C.; Reno, C. W. (RCA Advanced Tech. Labs., Camden, NJ). Appl. Opt.; 13: No. 11, 2457-2458(Nov 1974).

The design and operation of a 1.5-mm × 3-cm Nd^{3+} : YAG laser rod side pumped by a GaAs laser diode array tuned to the 8680-Å absorption line, achieving a multimode average output power of 120 mW for a total input power of 20 W to the final stage laser diode drivers are described. The pumped arrangement was designed to take advantage of the high brightness of a conventional GaAs array as a linear source by introducing the pump light through a slit into a close wrapped gold coated pump cavity. This cavity forms an integrating chamber for the pump light. (TFD)

25662 MINIMIZATION OF THE PRIME POWER CONSUMPTION OF A COUPLING-MODULATED GAS LASER TRANSMITTER. Degnan, J. J. (Goddard Space Flight Center, Greenbelt, MD). Appl. Opt.; 13: No. 11, 2489-2498(Nov 1974).

The prime power requirements of a coupling-modulated gas laser transmitter are discussed. The latter consists of a gas discharge tube and electrooptic modulator inside a laser resonator. In performing the calculations, the laser discharge length and the modulator voltage are simultaneously varied so that the transmitted power remains constant. In this way, tradeoffs can be made between the prime power supplied individually to the discharge tube and to the modulator driver to obtain a transmitter configuration that minimizes the total prime power consumption. An analytical expression is derived that describes the effects of information bandwidth and transmitter output power on the prime power requirements. Specific numerical results are obtained for a CO_2 laser transmitter based on presently available experimental data. (auth)

25663 THREE-DIMENSIONAL UNSTABLE RESONATOR CALCULATIONS WITH LASER MEDIUM. Rensch, D. B. (Hughes Research Labs., Malibu, CA). Appl. Opt.; 13: No. 11, 2546-2561(Nov 1974).

A numerical procedure that uses an explicit finite difference method to solve the wave equation is described. This technique results in a propagation algorithm that can accurately propagate an arbitrary electric field through a uniform medium or a medium that is nonuniform, transversely flowing, saturable, and contains index inhomogeneities. By using the propagation algorithm to propagate an arbitrary field back and forth between two resonator mirrors, the three-dimensional transverse mode and the output beam characteristics for a laser resonator can be determined. The advantage of the finite difference method is that unlike integral techniques the computational accuracy and efficiency improve as the resonator Fresnel number increases. The computational techniques are explained, and results for several specific empty cavity confocal unstable resonators are presented and compared to results obtained using an established calculation technique. The application of the finite difference method to inhomogeneous laser media is described, and computational results for an existing CO_2 gas dynamic laser are presented and compared to measured data. The medium kinetics and shock wave models used in the calculations are described. (auth)

25664 SINGLE-CRYSTAL ELECTROOPTIC THIN-FILM WAVEGUIDE MODULATORS FOR INFRARED LASER SYSTEMS. Lotspeich, J. F. (Hughes Research Labs., Malibu, CA). Appl. Opt.; 13: No. 11, 2529-2539(Nov 1974).

From Topical meeting on integrated optics; New Orleans, LA (21 Jan 1974).

Wideband, low power electrooptic modulators of optical waveguide structure have been developed for infrared laser applications. They allow a reduction in driver power of two orders of magnitude below that of conventional devices. The modulators are composed of very thin layers of single-crystal GaAs, bounded on both sides by evaporated films of lower refractive index material: CdTe or As_2S_3. Minimum propagation loss, measured at 10.6 μm, was less than 1 dB/cm for TE modes and less than 5 dB/cm for TM modes. A 20-pF modulator exhibited a pulse response rise time of 3 nsec and showed useful frequency response to beyond 200 MHz. The basic capability for advanced design modulators of this type to operate at 10 μm with driver powers of less than 25 mW/MHz for 50% modulation depth is shown. (auth)

25665 OPTICAL QUALITY OF PULSED ELECTRON-BEAM SUSTAINED LASERS. Pugh, E. R.; Wallace, J.; Jacob, J. H.; Northam, D. B.; Daugherty, J. D. (Avco-Everett Research Lab., Everett, MA). Appl. Opt.; 13: No. 11, 2512-2517(Nov 1974).

The optical quality of a pulsed atmospheric CO_2 electric laser was investigated. The density disturbances in the optical cavity are caused by edge waves originating at the anode and cathode. Volumetric heating effects associated with a nonuniform electric discharge are shown to be negligible. The disturbance propagating from the cathode results from a discontinuity in the spatial heating and the cathode fall. The wave emanating from the anode is associated with the presence of a solid surface that prevents the gas from expanding. As a result, lasers have to be designed with pulse durations much less than the acoustic transit time across the cavity. (auth)

25666 INDUCED γ RADIATION IN LONG-LIVED NUCLEAR ISOMERS. Arutyunyan, E. A. pp 284-287 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

Induced γ radiation and the possibility of making gamma laser were previously discussed. In the present study the possibility

of observing induced γ radiation in crystals enriched in long-lived nuclear isomers is examined theoretically. (JSR)

25667 OUTPUT PROPERTIES OF SHORT-PULSE GAIN-SWITCHED LASERS. Casperson, L.W. (University of California, School of Engineering and Applied Sciences, Los Angeles, California 90024). Appl. Opt. 14: No. 2, 299-305 (Feb 1975).

A formalism is derived for analyzing the spectral and temporal properties of gain-switched lasers. The development of the longitudinal mode structure from spontaneous emission, limiting linewidths, and over-all spectral characteristics are considered in detail; and applications are discussed. (auth)

25668 DISTRIBUTED FEEDBACK DYE LASER OF WAVELENGTH TUNABLE FROM 7470 A TO 8400 A. Bakos, J. S.; Fuzessy, Z.; Sorlei, Z.; Szigeti, J. (Central Research Inst. for Physics, Budapest). Phys. Lett., A; 50A: No. 3, 227-228(2 Dec 1974).

A 10^{-3} mol/lit solution of DDI (1,1'-diethyl-2,2'-dicarbocyanine iodide) was used in distributed feedback configuration for lasing. The operation characteristics of the laser, namely, the tuning range, the linewidth, the output power-pumping light power function, near and far field pattern were investigated. (auth)

25669 SEPARATING POLARIZATION AND FREQUENCIES OF HEAD-ON WAVES IN RING LASERS. Orlov, A. I.; Rubanov, V. S. pp 186-212 of Kvantovaya Elektronika i Lazernaya Spektroskopiya. Minsk; Nauka i Tekhnika (1974). (In Russian).

An examination is made of methods of creating polarization and polarization-frequency nonmutuality and the results of their investigation. A theoretical analysis is made of polarization-frequency characteristics of resonators on the basis of a method of calculation using Jones vectors and matrices. The experimental studies were done on helium-neon ring lasers emitting on a wavelength of 1.15 μm. The examined methods open up the possibility of creating lasers which emit waves with different polarization-frequency characteristics in head-on directions. Lasers of this kind are richer than conventional ones with respect to their characteristics, and open up extensive possibilities for research. (Referativnyi Zh.)

25670 SPIN LASERS ON RUBY IN ORGANIC DYE SOLUTION. Karpushko, F. V.; Rubanov, A. S. pp 100-124 of Kvantovaya Elektronika i Lazernaya Spektroskopiya. Minsk; Nauka i Tekhnika (1974). (In Russian).

Results of theoretical and experimental studies of spectral-kinetic singularities of emission of spin lasers on ruby in an organic dye solution in multiple sine-wave and linear sweep modes are presented. High-Q dispersion cavities with electronic control of tuning frequency developed at the Institute of Physics of the Belorussian SSR Academy of Sciences were used. (Referativnyi Zh.)

25671 SINGLE-FREQUENCY He-Ne LASER EMISSION (LAMBDA = 0.63 μm) AT HIGH PRESSURES OF THE ACTIVE MEDIUM. Saprykin, E. G. pp 221-224 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of single-frequency He-Ne laser emission (λ = 0.63 μm) at high pressures of the active medium. Due to the high helium pressure, the emission frequency is shifted relative to the central transition frequency typical of low pressures. Since there is a drop in the optimum discharge current, ballast resistors must be fairly large, and it is preferable to use additional high-frequency pumping to eliminate the possibility of development of plasma oscillations in the discharge. In order to reduce noises, two discharge gaps were used which were fed through separate current stabilizers. To achieve greater power in a single mode, it is necessary to isolate a single transverse wavemode. A tapered tube which copies the configuration of the resonator field facilitates isolation of longitudinal wavemodes since the thinner part of the tube makes the main contribution to amplification. A large gas volume throughout the tube increases the power of single-frequency emission. The transmission factor of the output mirror must be experimentally selected. (Referativnyi Zh.)

25672 RESEARCH ON SELECTION AND TUNING OF THE FREQUENCY OF LASERS ON MOLECULAR NITROGEN. Ishchenko, V. N.; Lisitsyn, V. N.; Chapovskii, P. L. pp 225-229 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of the possibility of tuning the frequency of emission of a molecular nitrogen laser. An examination is made of selection and frequency tuning of the emission of an N_2-laser in the infrared band, and ultraviolet emission of an N_2-laser at high pressures. The results are discussed. (Referativnyi Zh.)

25673 INVESTIGATION OF THE POLARIZATION CHARACTERISTICS OF LASERS ON ORGANIC DYES WITH PUMPING BY FLASH LAMPS. Nestrizhenko, Yu. A. pp 148-153 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of the possibility of achieving polarized emission in flash lamp pumping of rhodamine-6G and rhodamine-C solutions in methanol (concentration 7×10^{-5} mole/liter; the emission is most uniformly distributed over the cross section of the cell at this concentration). The results show the feasibility of achieving polarized stimulated emission by means of polaroids with weakly pronounced polarizing capacity, as well as the possibility of using polarizers with total internal reflection over a wide wavelength range. (Referativnyi Zh.)

25674 USING A CRYSTAL PLATE FOR SELECTION AND TUNING OF A DYE LASER. Belyaeva, N. N.; Novikov, M. A. pp 133-136 of Lazery s perestraivayemoy chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

The use of filters based on birefringent crystal plates for selection and frequency tuning in dye lasers is considered. Two schemes are presented for dye laser cavities in which birefringent plates of calcite (d = 0.7 cm) are placed to eliminate the influence of dichroism on emission output power. The spectrum consisted of a "comb" of frequencies with spacing of ~8 cm^{-1} between individual lines. To obtain emission on one of these lines, quartz plates 0.3 and 1.2 cm thick were used. The emission frequency can be adjusted within the limits of the luminescence line by changing the inclination of the plates. (Referativnyi Zh.)

25675 STABILIZING THE EMISSION OF NEODYMIUM-ACTIVATED ALUMINUM-YTTRIUM GARNET LASERS. Golyayev, Yu. D.; Dmitriyev, V. G. pp 48-50 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

The results of an investigation of the emission parameters of neodymium-activated aluminum-yttrium garnet lasers operating in the spontaneous emission mode are presented. An investigation was made of cases of multimode emission (with respect to transverse emission indices) and emission on the lower mode (TEM_{00}). The laser power supply provided operation with recurrence rate of 0 to 50 Hz, and permitted surpassing the threshold pumping level by a factor of 100. It was found that a decisive factor in a multimode laser for stabilizing emission characteristics and realizing a quasicontinuous emission mode is removal of nonuniformities of inverse population as a consequence of quasicontinuous filling of the volume of the active medium and emission spectrum with a large number of normal modes of the cavity. (Referativnyi Zh.)

25676 HIGH-POWER ELECTRIC DISCHARGE LASERS (EDLs). Reilly, J. P. (Avco-Everett Research Lab., Inc., Everett, MA). Astronaut. Aeronaut.; 13: No. 3, 52-64(Mar 1975).

A brief but inclusive summary of the most important aspects of the field of high-power electric discharge lasers is presented. The physics of the devices and what makes them work as efficient high-flux photon sources are discussed. (TFD)

25677 TRANSVERSELY PUMPED LNP LASER PERFORMANCE. Otsuka, K.; Yamada, T. (Nippon Telegraph and Telephone Public Corp., Tokyo). Appl. Phys. Lett.; 26: No. 6, 311-313(15 Mar 1975).

Quasicontinuous laser oscillation of lithium neodymium tetraphosphate of 2-mm length pumped transversely with a chopped argon laser is reported. The room-temperature threshold was 95 mW and the slope efficiency was 3.7%. The threshold of transverse pumping was 2.5 times that of longitudinal pumping; therefore, the relative pumping efficiency was 40%. (auth)

25678 OPTICALLY PUMPED VIBRATIONAL TRANSITION LASER IN OCS. Schlossberg, H. R. (Air Force Cambridge Research Lab., Bedford, MA); Fetterman, H. R. Appl. Phys. Lett.; 26: No. 6, 316-318(15 Mar 1975).

Laser oscillation between vibrational states has been demonstrated at 19 μm in OCS by optical pumping on the ν_2 overtone with a CO_2 TEA laser. Analysis of the molecular kinetics indicates this technique to be general and capable of yielding many high-power (>1000 W) laser lines below 50 μm. (auth)

25679 SINGLE-CRYSTAL FIBER OPTICAL DEVICES: A ND:YAG FIBER LASER. Burrus, C. A.; Stone, J. (Bell Labs., Holmdel, NJ). Appl. Phys. Lett.; 26: No. 6, 318-320(15 Mar 1975).

Single-crystal fibers of Nd:YAG have been grown in diameters as small as, but not limited to, 50 μm by a pedestal growth (modified zone melting) technique. Room-temperature cw laser operation has been achieved with 0.5 to 1-cm-long samples.

The method is directly applicable to the growth of single-crystal fibers of various materials for devices covering a wide range of applications, especially for optical communications. (auth)

25680 HIGH-POWER MODE-LOCKED TEA CO_2 LASER USING AN UNSTABLE RESONATOR. Dyer, P. E.; James, D. J. (Univ. of Hull, Eng.). Appl. Phys. Lett.; 26: No. 6, 331-334(15 Mar 1975).

A passively mode-locked TEA CO_2 laser has been operated with an unstable resonator, and mode-locked trains with peak powers > 150 MW, together with near diffraction-limited beams, have been obtained. Single axial mode operation at a power level of 14 MW has also been achieved. These results represent a significant improvement over similarly dimensioned systems using stable resonators. (auth)

25681 SIMPLE TEA LASER GEOMETRY WITH VOLUMETRIC PHOTOIONIZATION. Reits, B. J.; Olbertz, A. H. M. (Twente Univ. of Tech., Enschede, Netherlands). Appl. Phys. Lett.; 26: No. 6, 335-336(15 Mar 1975).

A weak uv source conditions a CO_2 laser gas discharge with the aid of the seed gas tri-n -propylamine. Rich mixtures and high input energy densities can be used, resulting in extremely high peak powers. (auth)

25682 SODIUM VAPOR LASER (372 Å) CALCULATIONS USING EXPLODING WIRE RADIATION. Jones, W. W.; Ali, A. W. (Naval Research Lab., Washington, DC). Phys. Lett.; 50A: No. 2, 101-102(18 Nov 1974).

Calculations indicate that the radiation from an exploding wire can pump a sodium vapor laser at (372 Å) with ample gain. (auth)

25683 TUNABLE SOLID STATE LASERS WITH DISPERSION CAVITIES. Kravchenko, V. I.; Soskin, M. S. pp 7-17 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

Results of studies of solid state lasers with dispersion cavities are presented. Problems of multifrequency emission of solids and the energy characteristics of tunable lasers are discussed. An examination is made of dispersion cavities, traveling wave lasers, spin lasers and etc. (Referativnyi Zh.)

25684 SELECTION OF TRANSITIONS IN LIGHT EMISSION OF A CARBON DIOXIDE LASER WITH THE AID OF AN ABSORPTIVE FILM SELECTOR. Avtonomov, V. P.; Antropov, E. T.; Sobolev, N. N.; Troitskii, Yu. V. pp 277-282 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

In view of the possibility of emission on lines of two bands (9.6 and 10.6 μm) in a carbon dioxide laser with nonselective cavity the spectral composition of emission in the general case is uncertain, and selective elements must be introduced into the cavity. An investigation is made of the possibilities of successfully using a film selector with thickness $d \ll \lambda$ introduced into lasers in the visible range for controlling the mode composition of emission. It is concluded that in spite of the mentioned limitations, the use of an absorptive film selector for singling out individual rotational lines of a carbon dioxide laser can be considered a practical feasibility. (Referativnyi Zh.)

25685 INFLUENCE OF HEAT STRESSES ON THE OPTICAL PROPERTIES OF ACTIVE RUBY ELEMENTS. Zheltov, G. I.; Polkanov, Yu. A. pp 146-156 of Kvantovaya Elektronika i Lazernaya Spektroskopiya. Minsk; Nauka i Tekhnika (1974). (In Russian).

Taking ruby as an example, the thermo-optical distortions of active elements made from crystals of the trigonal system (class 3 m) were examined. It is shown that cavity distortions are minimized by using plates with the optical axis oriented parallel to the surface as active laser elements. In this case the level of thermal deformations of an active element of ruby are only slightly greater than deformations of a plate of yttrium-aluminum garnet with orientation [001]. (Referativnyi Zh.)

25686 SINGULARITIES OF THE EMISSION SPECTRUM OF A LASER ON ARGON IN A MAGNETIC FIELD. Grimblatov, V. M.; Ostapchenko, E. P.; Teselkin, V. V. pp 261-264 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

Results of an investigation of the anomalous behavior of the emission spectrum of an argon laser with quartz capillary placed in an external axial magnetic field, and a linear two-mirror cavity are reported. The observed singularities of behavior of the spectrum are apparently due to the dual nature of interaction of the magnetic field (Zeeman splitting and change of discharge parameters) and the influence of Brewster windows. (Referativnyi Zh.)

25687 NOISES OF CO_2 SINGLE-FREQUENCY LASER EMISSION. Alekseyeva, A. N.; Pyatkova, L. M. pp 241-245 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

A study was made of emission noises of single-frequency carbon dioxide lasers and possible ways of reducing them. The studies were done in the single-frequency laser mode, which was verified by the spectral composition of the emission. In the presence of perturbations of the fundamental mode of oscillations due to misalignment of the cavity mirrors, beats of the transverse modes of oscillations showed up in the output signal of the photo-receiver, and if the frequency of these beats fell into the measurement range, a sharp increase in noises was observed. Studies of amplitude noises of emission were also done on a ternary gas mixture (with addition of air). In the steady-state laser mode the noises differed by a quantity lying within the limits of measurement error (3 $dB/Hz^{1/2}$). With a change of discharge current by ± 2 mA (close to optimum with respect to power) the spectral density of noises changed by an amount no greater than 10 $dB/Hz^{1/2}$. Thus it is shown that it is feasible to achieve a low level of amplitude emission noises in a carbon dioxide laser. (Referativnyi Zh.)

25688 PROBLEM OF USING SELECTIVE MIRRORS TO ACHIEVE SINGLE-FREQUENCY EMISSION IN A CO_2 LASER. Gorelik, A. V.; Markina, M. A.; Ogarev, Yu. N. pp 236-241 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of the temperature instability of plane-parallel selective mirror plates, leading to considerable instability of the emission spectrum of a CO_2 laser. Mirror plates of germanium and gallium arsenide are used and laboratory models of a laser on carbon dioxide mixed with air and helium are made with emission power of 3 and 15 W. Unimodality of emission was achieved by selection of the parameters of the plane–sphere cavity and the diameter of the discharge tube. It is established that with unimodality, and fixation of certain lengths of the cavity and temperature of the mirror plate appropriately selected it is possible to achieve a single-frequency mode of emission and to make an oriented adjustment of the wave-length of the emission by varying these parameters. It is noted that a generalized criterion for selecting the material of the selective plate mirror can facilitate the search for materials suitable for such plates. (Referativnyi Zh.)

25689 CONCERNING THE CHANGE OF EMISSION FREQUENCY DUE TO TRANSIENT PROCESSES IN DYE SOLUTION LASERS. Bereza, V. N.; Gandel'man, I. L.; Nikolayenko, A. N.; Tikhonov, E. A. pp 156-162 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An analysis was made of possible mechanisms of sweeping of the emission frequency of organic dye lasers. It is shown that with laser pumping by nanosecond pulses one of the most common and important causes of long-wave displacement is nonstationarity of emission. It is experimentally shown that there are frequency shifts in organic dyes due to nonstationary processes in the nanosecond mode. An investigation is made of the conditions of observation of fluctuations in the laser output emission based on organic dyes with nanosecond pumping. (Referativnyi Zh.)

25690 CONCERNING THE POSSIBILITY OF STABILIZING LASER FREQUENCY BY USING NONLINEAR RADIO-OPTICAL PHENOMENA. Vladimirov, V. M.; Pikhtelev, A. I. pp 285-299 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

Two schemes of laser frequency stabilization are considered: (1) a scheme for phase AFC of the laser according to a quantum standard in which the maser control element is a stabilized laser; and (2) a scheme with passive observation of the atomic transition line in which the converter is a passive quantum frequency standard where the emission of a stabilized laser is used as the stabilized pumping source. The relative instability of the laser frequency with stabilization in scheme (2) may be appreciably less than with the same values of conversion transconductance as in scheme (1), since the instability of the laser frequency is converted to instability of the frequency of a quartz crystal oscillator, which is three orders lower than the frequency of the resonance transition in the atom (e.g., ^{87}Rb). It is noted that short-term instability of scheme (2) is increased by increasing time of conversion of laser frequency instability to quartz crystal oscillator frequency instability. (Referativnyi Zh.)

25691 DISCHARGE TUBES FOR MULTICOMPONENT CATAPHORESIS LASERS. Ivanov, I. G.; Il'yushko, V. G.; Mikhalevskii,

V. S.; Mukhanov, V. P.; Sem, M. F. (Rostov-on-Don State Univ., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1136-1137(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 161-162(1974).

Constructions of discharge tubes are proposed which allow the radiation spectrum of cataphoresis lasers to be broadened by using several working substances in them. (auth)

25692 COMPLEX ORGANIC COMPOUND VAPOR LASER. Borisevich, N. A.; Kalosha, I. I.; Tolkachev, V. A. (Inst. of Physics, Minsk). Dokl. Akad. Nauk SSSR; 218: No. 1, 74-76(1 Sep 1974). (In Russian).

The effect of a contaminant gas pentane on the frequency and other characteristics of the generated radiation of bis-phenyl-oxazolybenzene (POPOP) vapor was studied. (JSR)

25693 EMISSION SPECTRUM OF SOLID STATE LASERS WITH DEEP MODULATION. Mukhtarov, Ch. K. pp 299-300 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

A study was made of the spectral kinetics of emission in resonators with flat extended mirrors with parallel dielectric boundaries with deep modulation of thresholds. Modulation is caused by periodic redistribution of the energy as a consequence of monotonic variation of the resonator parameters. It is established that in the investigated lasers the instability of resonator parameters leads both to unsteady emission and to multimodality of emission. (Referativnyi Zh.)

25694 IMPROVED TUNING APPARATUS FOR A DYE LASER. Yarborough, J. M.; Hobart, J. L. (to Coherent Radiation). US Patent 3,868,592. 25 Feb 1975. Filed date 30 May 1973. 6p.

One or more birefringent plates are placed within the optical cavity of a dye laser. Each of the plates is positioned at an angle, such as Brewster's angle with respect to the light reflected within the optical cavity of the dye laser. The output wavelength from the dye laser is tuned by rotating the birefringent plates while maintaining the plates at the same angle. (Official Gazette)

25695 LASER HEAD FOR SIMULTANEOUS OPTICAL PUMPING OF SEVERAL DYE LASERS. Mumola, P. B.; McAlexander, B. T. (to Administrator of the National Aeronautics and Space Administration). US Patent 3,868,591. 25 Feb 1975. Filed date 5 Jun 1973. 4p.

The invention is a laser head for simultaneous pumping several dye lasers with a single flashlamp. The laser head includes primarily a multi-elliptical cylinder cavity with a single flash lamp placed along the common focal axis of the cavity and with capillary tube dye cells placed along each of the other focal axes of the cavity. The inside surface of the cavity is polished. Hence, the single flashlamp supplies the energy to the several dye cells. (Official Gazette)

25696 NARROW BANDWIDTH DYE LASER. Itzkan, I.; Caristi, R. F. (to AVCO-Everett Research Lab., Inc.). US Patent 3,868,590. 25 Feb 1975. Filed date 2 May 1973. 4p.

A dye laser has a dye cell containing a lasable dye material. A diffraction grating and a partially reflective mirror form an optical cavity having an axis through the dye cell coincident with the axis of a focused pumping radiation beam from a pulsed nitrogen laser. A lens system comprising a quartz rod and a collimating lens is positioned between the cell and the diffraction grating to illuminate a greater area of the grating and thus narrow the bandwidth of the laser beam produced without substantially increasing the length of the optical cavity. (Official Gazette)

25697 THIN FILM DEVICES AND LASERS. Wang, S. (to the Regents of the Univ. of California). US Patent 3,868,589. 25 Feb 1975. Filed date 12 Feb 1973. 34p.

New periodic structures are proposed for making thin film optical devices such as lasers and passive devices such as filters and modulators utilizing the thickness variation introduced in a multi-layer thin film optical waveguide. Wave propagation in such structures is analyzed. Expressions are derived for the amount of distributed feedback and possible scattering losses. From the coupled-wave equations, the laser-oscillation conditions are developed. Examples of the invention are given for making distributed feedback lasers in several configurations and with semi-conductor, dye and solid-state materials. (Official Gazette)

25698 Q-SWITCHING DEVICE FOR GLASS LASERS. Greenberg, C. B. (to PPG-Industries, Inc.). US Patent 3,865,747. 11 Feb 1975. Filed date 21 Aug 1970. 10p.

An improved Q-switched neodymium laser in which uranium as UO_2^{+2} and a uranium oxidizing agent such as cerium in a host body such as glass serve as either an external or an internal Q-switching device for the laser is described. (Official Gazette)

25699 MIRROR MOUNT FOR A LASER. Hobart, J. L.; Mefferd, W. S. (to Coherent Radiation Labs.). US Patent 3,865,472. 11 Feb 1975. Filed date 24 Apr 1972. 6p.

The invention consists of a mirror mount for mounting a laser mirror on a body in communication with a gas laser medium which comprises a body having a flat mirror support face thereon and a bore extending through said body from said face; a laser mirror engaging said mirror support face and covering said bore; a mounting plate on the opposite side of said mirror from said body and mounted on said body with said mounting plate having a central area adjacent to said mirror, a peripheral seal between said body and said plate outside the periphery of said mirror; a resilient O-ring compressed between said mirror and said plate between said central area of said plate and said peripheral seal with said O-ring resiliently holding said mirror against said mirror support face; and a through passageway extending past said O-ring from said central area for preventing air pressure differentials across said mirror. (Official Gazette)

25700 HOLLOW-CATHODE LASER TUBE. Fukuda, S.; Miya, M. (to Nippon Electric Co., Ltd.). US Patent 3,868,593. 25 Feb 1975. Priority date 17 Oct 1972, Japan. 8p.

A hollow-cathode metal vapor laser tube is disclosed in which a hollow cathode is composed of a plurality of tubular cathode members aligned along a common axis and axially spaced from one another. The anode is composed of a plurality of tubular anode members interposed between adjacent cathode members and surrounding the cathode members. The several cathode member–anode member combinations are electrically insulated to permit the separate application of excitation power thereto. (Official Gazette)

25701 GAIN IN THE OUTPUT EFFICIENCY OF LASERS BASED ON ORGANIC DYE SOLUTIONS. Dzyubenko, M. I.; Matveev, A. Ya.; Naumenko, I. G. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 4, 423-425(Oct 1974).

Translated from Opt. Spektrosk.; 37: No. 4, 745-749(Oct 1974).

The possibility of increasing the efficiency and the region of smooth tuning of the laser frequency for mixtures of solutions of nine dye pairs as a result of the transfer of excitation energy from a donor dye molecule to an acceptor dye molecule is studied. The concentration dependence of the laser threshold and output power is investigated. The maximum increase in output power (2.2 times) was observed for the rhodamine 6G and cresol violet dye pair. Variation in the concentration of each dye in a prismatic dispersive resonator produced smooth wavelength tuning over the region from 575 to 705 nm. Preliminary criteria are formulated for the suitability of dyes for multicomponent solutions for lasers. (auth)

25702 EXPERIMENTAL INVESTIGATION OF A He–Ne LASER WITH A DISCHARGE GAP OF RECTANGULAR CROSS SECTION. Privalov, V. E.; Khodovoi, V. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 4, 455-457(Oct 1974).

Translated from Opt. Spektrosk.; 37: No. 4, 797-799(Oct 1974).

The gain in a He–Ne discharge (0.63 μm) only decreases when the transverse dimensions of the tube of rectangular cross section are increased. The power emitted by the He–Ne laser has a maximum for certain transverse dimensions of the tube. For dimensions less than the optimum values, an increase in one of the sides of the cross section increases the mode volume, gives a more uniform transverse distribution of the active atoms in this volume, and increases the number of active atoms in the discharge. This facilitates lasing. For dimensions greater than the optimum values, an increase in the cross section has almost no effect on the mode volume, reduces the diffraction losses of only the higher-order modes, and begins to reduce considerably the number of active atoms on the axis, and the replenishment of active atoms in the wings of the spatial distribution occurs even beyond the limits of the mode volume, i.e., a reduction in the mean gain is the main process, and the power falls. By using tubes of rectangular cross section in ring lasers, with transverse dimensions greater than the optimum value, a reduction in the gain and a broader distribution is obtained, which makes it less critical to changes in the parameters of the medium and of the resonator. In addition, a rectangular aperture corresponds better to the cross section of the caustic of the field of the ring resonator for the fundamental mode of oscillation. (auth)

25703 RADIATION-CHEMICAL LASER USING $SF_6 + H_2$ AND $CCl_2F_2 + H_2$ MIXTURES AT PRESSURES UP TO 3 ATM. Dovbysh, L. E.; Zavada, N. I.; Kazakevich, A. T.; Karpikov, A. A.; Mel'nikov, S. P.; Podmoshenskii, I. V.; Sinyanskii, A. A. JETP Lett. (USSR) (Engl. Transl.); 20: No. 6, 183-184(20 Sep 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 6, 407-410(20 Sep 1974).

Generation was produced in the gas mixtures $SF_6 + H_2$ and

$CCl_2F_2 + H_2$ excited by an electron beam from an accelerator. The laser-radiation energy increases linearly with pressure up to 3 atm. For the optimal $SF_6 + H_2$ mixture (6:1), the efficiency of the system was not less than 5%. Addition of He to the mixture does not affect the energy of the laser radiation. (auth)

25704 INVESTIGATIONS OF THE LIFETIME OF SEALED-OFF CO_2 LASERS. Donnerhacke, K. H. (Univ., Jena, Ger.). Exp. Tech. Phys.; 22: No. 4, 301-314(1974). (In German).

A summary is given of the different methods for achieving long lifetimes in sealed-off CO_2 lasers. The apparently best technique, addition of water vapor or hydrogen to the gas mixture, was verified experimentally. From the experiments the following conclusions were drawn: a continuous addition of H_2O or H_2 is necessary in order to obtain a long lifetime; and besides the temperature of the electrodes must be so high, that possible adsorption processes on the surface are largely suppressed. (auth)

25705 FREQUENCY BEATS BETWEEN ORTHOGONAL POLARIZATIONS IN A WATER-VAPOR LASER. Zav'yalov, V. V.; Bogomolov, G. D. JETP Lett. (USSR) (Engl. Transl.); 20: No. 6, 176-177(20 Sep 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 6, 393-395(20 Sep 1974).

Generation of two orthogonal linear polarizations belonging to the same resonator mode and differing in frequency by several dozen kHz was observed in a water-vapor laser whose beam was extracted through a thin grid. It is shown that the difference between the frequencies is due to anisotropy of the grid. (auth)

25706 CONVERSION OF A COMMERCIAL CO_2 LASER TO CO OPERATION AT 5.6μ. Davis, J. A. (Illinois Inst. of Tech., Chicago). Rev. Sci. Instrum.; 46: No. 3, 323-324(Mar 1975).

Modifications on a commercial room temperature CO_2 laser to create a CO laser are discussed. Powers of 1 W were easily obtained in the 5.4 to 5.6 μ wavelength region. (auth)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstract 26558.

25707 (AD-787010) NOISE IN THE rf SQUID. Jackel, L. D.; Buhrman, R. A. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). 1 Oct 1974. 103p. (MSC-2321; TR-23). NTIS $5.25.

The paper presents the results of an extensive study of the sensitivity limiting noise sources in rf-biased SQUID flux detectors. The investigation include both experiments with point contact and thin film SQUIDS and digital computer simulations. (GRA)

25708 (CONF-730805-10) SUPERCONDUCTING ELECTRICAL GENERATORS FOR CENTRAL POWER STATION USE. Flynn, T. M.; Powell, R. L.; Chelton, D. B.; Birmingham, B. W. (National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). [nd]. 17p. Dep. NTIS $4.00.

From Cryogenic engineering conference; Atlanta, Georgia, USA (8 Aug 1973).

The status of development of large superconducting electrical generators is briefly reviewed. Results of three studies are outlined: (1) a market appraisal and economic analysis to assess commercial potential and economic impact; (2) a study on applications of superconducting machinery to determine future machinery needs of the electric power industry; and (3) a study on technical problem identification to determine the critical components, materials, and systems and suggest an appropriate R and D program. (WHK)

25709 (CONF-730941-, pp 89-94) SUPERCONDUCTING MAGNET SYSTEM FOR MAGNETIC GUIDANCE OF CEREBRAL CATHETERS. Montgomery, D. B. (Massachusetts Inst. of Tech., Cambridge). 1973.

From grantees conference on instrumentation technology; Washington, District of Columbia, USA (25 Sep 1973).

In proceedings of the grantees conference on instrumentation technology.

The development of a magnetically guided catheter system using a superconducting magnet, for use in the major vessels of the human cerebrovascular system is described. Some of the major applications that have been explored in the research laboratory, using about 150 canines, are discussed, to give an indication of the techniques which a magnetically guided catheter is capable of performing. The superconducting magnet now being built will make these applications finally reliable in man. (WHK)

25710 (CONF-730941-, pp 146-164) SUPERCONDUCTING MAGNETOMETRY FOR DETECTION OF HEART DISEASE. Fairbank, W. M.; Wikswo, J. (Stanford Univ., CA). 1973.

From grantees conference on instrumentation technology; Washington, District of Columbia, USA (25 Sep 1973).

In proceedings of the grantees conference on instrumentation technology.

The operation and use of a SQUID magnetometer for measuring blood flow in the human heart for diagnosing heart disease are described. (WHK)

25711 (LBL-2544) JOSEPHSON JUNCTION BOLOMETER. Clarke, J.; Hoffer, G. I.; Richards, P. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1974. Contract W-7405-eng-48. 3p. (CONF-740694-1). Dep. NTIS $4.00.

From international conference on submillimeter waves and their applications; Atlanta, Georgia, USA (5 Jun 1974).

A bolometer for use in the submillimeter and far infrared is described. The temperature sensitive element is an SNS Josephson junction. The electrical NEP is 5×10^{-15} W/Hz$^{1/2}$ and the detectivity, D, is 10^{14} cm Hz$^{1/2}$ W^{-1}. (auth)

25712 (ORNL-tr-2902) ELECTRODYNAMIC STRAINS AND MECHANICAL STRESSES IN SUPERCONDUCTING MAGNETIC SYSTEMS. Novitskii, V. G.; Shakhtarin, V. N. Translated by M. Gerrard, Oak Ridge National Lab., TN, from Dokl. Akad. Nauk SSSR; No. 2, 50-55(1972). 7p. Dep. NTIS $4.00.

Formulas are given for use in making calculations on the mechanical stability of superconducting magnetic systems which are frequently found in practice. The mechanical stress may be found both in the winding itself and in the structural elements. The most serious problem, determination of the mechanical stresses in the coil, should be solved with consideration of the axial components of the electrodynamic forces acting on the conductor of the coil. (auth)

25713 COOLING BY COMPRESSION OF ^{3}He IN THE MIXING CHAMBER OF THE LEIDEN ALTERNATIVE DILUTION REFRIGERATOR. Satoh, T.; Jurriens, R. G.; Taconis, K. W.; de Bruyn Ouboter, R. (Rijksuniversiteit Leiden (Netherlands). Kamerlingh Onnes Lab.). Physica; 77: No. 3, 523-531(1 Nov 1974).

The mixing chamber of the Lieden alternative dilution refrigerator has been used as a compression cell for Pomeranchuk cooling. A description is given of the construction of this cooling device and its performance. The lowest magnetic temperature reached so far is 1.8 mK. (auth)

25714 TECHNOLOGICAL PROSPECTS OF THE USE OF SUPERCONDUCTIVITY IN ELECTRIC MOTORS. Mueller, G.; Markert, W. (Technische Hochschule, Ilmeanu, Ger.). Elektrie; 28: No. 1, 30-31(1974). (In German).

Synchronous and dc electric motors with superconducting field coils are briefly discussed. For synchronous motors, the design involving fixed armature and rotating superconductive field coil is the most promising. Synchronous motors with superconductive field coils are likely to find use in power generators, ship drives, and on-board generators in heavy aircraft. For dc electric motors, the design involving fixed armature of normal conductivity rotating superconductive field coil, and a controlled electronic "commutator" is the most promising; there is also a potential for motors with unipolar voltage induction and stationary superconductive field coil. Methods for shielding the field coils are discussed. (JPRS)

25715 SUPRACONDUCTING POWER CABLES (A REVIEW). Fluegge, D.; Heidmann, G. (Oberspree Cable Works Combine, East Berlin). Elektrie; 27: No. 7, 375-381(1973). (In German).

Literature dealing with the following subjects is reviewed: potential applications of low-temperature technology in the field of power cables, technical requirements for power cables with special emphasis on the use of superconducting materials, the design of superconducting power cables (thermal insulation of superconducting dc and ac power cables, cooling systems for the cables, conductor system for the cables, electric insulation of superconducting ac power cables, designing the cable system, conductor design and electric insulation of superconducting power cables), and current activities in the field of superconductive power cable development in the principal industrialized countries (Great Britain, France, USSR, US, Austria, and German Federal Republic). (JPRS)

25716 SIMPLE METHOD OF DETERMINING THE EXTERNAL SIGNAL VOLTAGE IN JOSEPHSON JUNCTIONS. Somervuo, P.; Sirkeinen, Y. (Radio Laboratory, Helsinki University of Technology, SF-02150 Otaniemi, Finland). J. Appl. Phys. 46: No. 3, 1415-1416 (Mar 1975).

A simple method is presented to obtain the voltage amplitude which is generated by an external microwave signal in a Josephson junction. The signal power and the efficiency of the coupling may thus be estimated. The method is based on the Bessel function obeying behavior of the constant voltage steps in the junction characteristics using a relatively high irradiating power. (auth)

25717 TEMPERATURE DEPENDENCE OF THE MAXIMUM JOSEPHSON CURRENT FOR Nb–NbO_x–Pb JUNCTIONS. Paternò, G. (Laboratori Nazionali del CNEN, Frascati, Italy); Rissman, P.; Vaglio, R. J. Appl. Phys. 46: No. 3, 1419-1420 (Mar 1975).

Measurements of the maximum Josephson current with temperature for Nb–NbO_x–Pb junctions differ from the BCS Ambegaokar–Baratoff curve. This cannot be explained in terms of strong coupling effects. A possible explanation might be proximity effect of a normal layer on the niobium surface. (auth)

25718 SUPERCONDUCTING QUANTUM INTERFEROMETERS MADE OF THIN FILMS. Richter, W.; Albrecht, G. (Friedrich-Schiller-Univ., Jena, Ger.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1196-1198(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 205-207(1974).

An experimental investigation was made of the properties of stable and replicable superconducting quantum interferometers made of thin films that had been vacuum deposited on a flat glass substrate. Their advantages and shortcomings compared with quantum interferometers based on point contacts were considered. (auth)

25719 JOSEPHSON DEVICE THRESHOLD GATES. Landman, B. S. (to International Business Machines Corp.). US Patent 3,868,515. 25 Feb 1975. Filed Date 29 Dec 1972. 6p.

Threshold logic gates are provided using Josephson devices to perform the weighting and threshold functions. The input currents are provided as control currents to vary the critical switching currents of respective series connected Josephson devices. A logic 1 input switches the associated Josephson device or devices from the V = 0 state to the V = Δ state. An alternate parallel path is provided. The alternate path carries a current which is effectively the sum of the weighted logic inputs. A further Josephson device is positioned to be influenced by the current in said alternate path whereby the further Josephson device switches from the V = 0 state to the V = Δ state when the threshold function is achieved. (Official Gazette)

25720 THERMAL CONSIDERATIONS IN THE DESIGN OF SUPERCONDUCTING GENERATORS. Fagan, T. J. Jr. 74-WA/HT-23. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

The thermal design of rotating superconducting field windings is discussed. The various heat flows into the low temperature winding structure are classified and their magnitude discussed. Methods of minimizing the most significant heat flows are described. Various methods of utilizing the helium coolant to maintain the winding at the required temperature are compared. These include conduction cooling, pool boiling, forced convection boiling and supercritical forced convection cooling. The use of exhaust helium to reduce the heat flows into the low temperature winding area due to heat conduction through structural members and heat conduction and I^2R heating in normally conducting electrical leads is appraised. The composition, placement and temperature control of thermal radiation and electro-magnetic shields is considered. Results indicate that for ship propulsion machines low temperature heat flows can be kept small enough so that the volume, weight and power consumption of the cryogenic refrigeration equipment required to remove these heat flows do not detract significantly from the volume, weight and efficiency advantages of the superconducting machine over conventional ship propulsion machinery. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 25628, 25805, 28339, 28407, 28706, 28720, 28739, and 28743.

25721 (AGC-8209-64-11) THERMAL ANALYSIS OF U-TUBE NOZZLE UNDER MAXIMUM LH_2/LO_2 CHEMICAL FIRING CONDITIONS. Thomas, E. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Mar 1964. 255p. Dep. NTIS $15.75.

Transient thermal analyses were performed on the steel jacket of the U-tube nozzle under conditions of maximum LO_2/LH_2 simulation, in which rated coolant flow was admitted with a ramp of 1.3 seconds duration. Analyses were made for three different jacket thicknesses, 100%, 75%, and 50% of the design value from Print No. 285950. Analyses were performed with the nozzle attached to two different pressure vessel adapter designs, one of aluminum, and one of steel. Analyses were made for conditions of both intimate contact and infinite resistance between the nozzle and each pressure vessel adapter. The nozzle and adapter were assumed to be at ambient temperature initially, i.e., no pre-chill, for each analysis. The highest thermal gradients appear in the region of the nozzle–pressure vessel flange. Although the chill-down is quite severe, there is no thermal shock problem. The effect of the aluminum or steel adapter on the flange of the nozzle during chill down is negligible. (auth)

25722 (FEI-460) MEASUREMENT OF LOCAL TEMPERATURE OF THE WALL DURING BUBBLE BOILING. Sorokin, D. N.; Tsyganok, A. A.; Gribov, A. A.; Mityaev, N. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The results of the measurement of the temperature of heat transfer surfaces under steam bubbles and of the surface during bubble growth and breakup are reported. It is shown that both for individual and interacting bubbles during boiling on flat and cylindrical heaters, a significant temperature drop of the heat transfer surface occurs only in the region of contact of the bubble with the wall in the period of bubble growth. Aside from this zones of significant change of the surface temperatures were not detected. (tr-auth)

25723 (RP-TR-0008) HEAT TRANSFER TO CRYOGENIC HYDROGEN FLOWING TURBULENTLY IN STRAIGHT AND CURVED TUBES AT HIGH HEAT FLUXES. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1966. 130p. Dep. NTIS $9.50.

The forced-convection heat-transfer characteristics of cryogenic hydrogen were studied in straight and curved tubes at pressures ranging from 800 to 1500 psi and fluxes from 8 to 27 Btu/in.^{2}-sec. The tests were conducted under conditions simulating those predicted for the Phoebus-2 nozzle, in support of the nozzle development program, and the test data were compared with the Hess and Kunz film-temperature equation. This equation, with a modified coefficient, represented both the straight and curved-tube test data. The dependency of the coefficient in terms of coolant temperature and geometrical configuration (i.e., radius of curvature and angular distance for curved tubes) was empirically evaluated, and the selection of a variable C_L as a multiplying factor for modifying the coefficient in the straight and curved portions of the nozzle, respectively, was substantiated. (auth)

25724 (SAND-75-5171) FINITE ELEMENT ANALYSIS OF VISCOUS, INCOMPRESSIBLE FLUID FLOW. Gartling, D. K.; Becker, E. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. AT(29-1)-789. 16p. Dep. NTIS $4.00.

A numerical procedure was developed for the analysis of general two-dimensional flows of viscous, incompressible fluids, using the finite element method. The partial differential equations describing the continuum motion of the fluid were discretized by using an integral energy balance approach in conjunction with the finite element approximation. The nonlinear algebraic equations resulting from the discretization process were solved, using a Picard iteration technique. A number of computational procedures were developed that allowed significant reductions to be made in the computational effort required for the analysis of many flow problems. These techniques include a coarse-to-fine-mesh rezone procedure for the detailed study of regions of particular interest in a flow field and a special finite element to model far field regions in external flow problems. The formulation of the basic discrete problem is given in the next section, followed by a discussion of a simple but effective solution algorithm in the third section. The fourth and fifth sections present the development of a coarse-to-fine-mesh rezone procedure and a special finite element for use in external flow problems. (auth)

25725 (TID/SNA-882) ENGINEERING OPERATIONS REPORT: LIQUID JET PENETRATION AND DROPLET VAPORIZATION COMPUTER CODE. Mockenhaupt, J. D.; Thompson, W. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 May 1972. 90p. Dep. NTIS $7.50.

A computer program was developed for calculating the penetration of a liquid jet injected laterally into a high-velocity gas stream, the breakup of the jet into droplets, and the subsequent vaporization of the droplets. A variable number of droplet sizes can be chosen to represent the over-all droplet size distribution and two-dimensional trajectories for each droplet size are calculated. A one-dimensional analysis, in which the gas properties are assumed to be constant across the duct at any given axial station, is used to determine the effect of the vaporizing droplets on the gas stream. Results for a typical case are presented and

discussed. It is recommended that this program be utilized to expedite design when direct fluid injection into a hot gas stream is used to cool or otherwise modify the gas flow field. (auth)

25726 (WANL-TME-379) HORIZONTAL MULTIPLE PASSAGE TRANSIENT BOILING FLOW WITH NO HEATING. Chi, J. W. H.; Campi, F. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 May 1963. 21p. Dep. NTIS $4.25.

An experimental study on transient boiling two-phase flow of hydrogen through a horizontal, multiple channel test section has been completed. From the stream temperature traces obtained, it has been concluded that the flow through the three passages was unevenly distributed. Local two-phase heat transfer coefficients were calculated from the data, but considerable scatter was obtained. Since the flow rates through each passage could not be determined, a detailed analysis and correlation of the data was not possible. Suggestions for future studies on multiple channel flow have been given. (auth)

25727 IMPROVED METHOD FOR ANALYZING HEAT TRANSFER AND PRESSURE DROP TESTS ON ROUGHENED RODS IN SMOOTH CHANNELS. Warburton, C.; Pirie, M. A. M. Paper No. 74-WA/HT-56. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A method is presented for the interpretation of heat transfer and pressure drop measurements on roughened rods tested in smooth channels. The method, which is also applicalbe to multi-rod cluster pressure drop results is a refinement of that of Nathan and Pirie using an improved correlation to represent the smooth surface friction factor. Both methods are developments of the method of Wilkie, but depend on locating the true surface of zero shear stress in the fluid. Meaningful rough and smooth surface friction factors can now be obtained over the whole range of turbulent Reynolds number without the need for time consuming velocity and temperature traverses. (auth)

25728 STRUCTURE OF ACOUSTIC NOISE SPECTRA IN SUBCOOLED POOL BOILING. Nishihara, H.; Bessho, Y. Paper No. 74-WA/HT-31. New York; American Society of Mechanical Engineers (1974). 9p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Structure of frequency spectra of acoustic noise generated by nucleate pool boiling of water at atmospheric pressure from boiling inception to the burnout of the heater was investigated experimentally. The effect of dissolved gas content on the noise spectra was also studied. The spectra of boiling noise extended to and possibly beyond 50 kHz, and behaved differently for heat fluxes above and below a certain heat flux level at which the overall noise intensity assumed a maximum value. For heat fluxes exceeding the maximum intensity heat flux the decrease in the acoustic intensity was due to the decrease in the frequency component above approximately 3 kHz, while for lower heat fluxes the shape of the noise spectra remained practically unchanged. The noise spectrum was also found to decrease for all the frequency components more or less uniformly with an increase of the dissolved gas content. (auth)

25729 TRANSIENT POOL-BOILING HEAT TRANSFER. Sakurai, A.; Shiotsu, M. Paper No. 74-WA/HT-41. New York; American Society of Mechanical Engineers (1974). 16p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Transient boiling heat transfer for exponential heat input to a platinum wire supported horizontally in a pool of water was investigated. Transient incipient boiling superheat was measured for various exponential periods under atmospheric pressure. A model for the transient incipient boiling was suggested. Transient DNB and maximum heat fluxes were obtained for exponential periods ranging from 5 millisecond to 10 second and for system pressures ranging from 0 to 20 atg. The mechanism of the temperature overshoot in the transient boiling was suggested. Initial heat flux was varied from zero to near the stationary maximum heat flux. Effect of the initial heat flux on transient DNB and maximum heat fluxes was negligible in saturated boiling. It was confirmed that quasi-stationary nucleate boiling with a certain life time exists on the linear extension of the stationary nucleate boiling curve on log-log graph. (auth)

25730 TRANSIENT HEAT TRANSFER CHARACTERISTICS OF LIQUID HELIUM. Tsukamoto, O.; Kobayashi, S. (Faculty of Engineering, Yokohama National University, Ohka Minami-ku, Yokohama, Kanagawa, Japan). J. Appl. Phys. 46: No. 3, 1359-1364 (Mar 1975).

The transient heat transfer characteristics of liquid helium are experimentally studied. Critical burnout heat fluxes for pulsive heating are measured, and empirical relations between the critical burnout heat flux and the length of the heat pulse are given. The burnout is detected by observing the super-to-normal transition of the temperature sensor which is a thin lead film prepared on the heated surface by vacuum evaporation. (auth)

25731 IMPROVEMENTS IN PLATE HEAT-EXCHANGERS AND ENERGY GENERATING THERMAL INSTALLATIONS COMPRISING SAME. (to Societe Babcock-Atlantique, 75-Paris (France)). French Patent 2182686/E/. 4 May 1972. 15p. (In French).

Addition to the French patent document 7106034; available from Institut National de la Propriete Industrielle, Paris (France).

The exchanger, mounted within an enclosure, comprises juxtaposed vertical plates, alternately provided with corrugations having two directions, a compartment defined by two of such plates being thus provided with two channel networks at an angle with respect to each other. (FR)

25732 MEASUREMENTS OF PARAMETERS OF THE GAS-PARTICLES FLOWS WITH OPTICAL METHODS. Rozenshtein, A. (Inst. of Thermophysics and Electrophysics, Tartu). Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 23: No. 4, 384-390(1974). (In Russian).

The possibility of measuring, by optical methods, the various parameters in two-phase flows is discussed. The block diagram of a laser Doppler anemometer and laser device for measuring the concentration of particles is described. The comparison of experimental results with other methods is presented. (auth)

25733 LIQUID METAL FLOW IN HORIZONTAL RODS. MacAulay, L. C. Vancouver, B. C.; British Columbia Univ. (1972). 239p.

Thesis.

Radioactive tracer techniques have been developed which allow direct in situ observation of the nature of fluid flow in liquid tin contained in a long shallow covered horizontal boat. An extensive series of experiments was conducted in order to confirm the acceptability and accuracy of the techniques employed. The findings of the investigation establish the dependence of flow velocity on temperature difference across the melt, average melt temperature and total melt length. The flow velocity was observed to increase linearly with the average temperature gradient between the hot and cold ends of the melt. An increase in flow velocity with increasing average melt temperature was also observed. Flow was observed to occur at very small temperature gradients. When the temperature gradient was zero at any point between the hot and cold ends of the melt, two flow cells developed. Convective mass transfer did not occur between these two cells. Autoradiography of quenched specimens showed the flow pattern to be a laminar unicellular longitudinal flow upon which a traverse double cell flow is superimposed. The results of the flow pattern and flow velocity experiments are compared to a modification of Batchelor's solution of thermal convection in a rectangular enclosure. In general, the agreement between the experimental results and the modified solution is good. A separate investigation of the macrosegregation associated with casting structure controlled by forced convection is also presented. (auth)

25734 ENGINEERING APPLICATIONS OF ADI METHODS TO PIECEWISE LINEAR MULTIDIMENSIONAL HEAT TRANSFER. Smith, J. H. (Los Alamos Scientific Lab., NM). J. Comput. Phys.; 17: No. 2, 181-191(Feb 1975).

Transient multidimensional forms of the heat equation are developed with alternating-direction-implicit (ADI) methods. Nonlinearities which stem from boundary conditions and variable properties are approximated in a piecewise linear manner. The resulting ADI forms of the heat equation are successfully demonstrated on a diverse pair of applications consisting of an air-to-ground missile design and an orbiting hollow cube exposed to short-duration radiation. In both applications, the ADI equations prove to be an order of magnitude more economical of computer time than the traditional Crank-Nicolson method. Moreover, the ADI equations prove to be less sensitive to approximation of nonlinearities than the DuFort-Frankel explicit method. (auth)

Materials Testing

Refer also to abstracts 25486, 25614, and 25970.

25735 (TID/SNA-748) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct System Preliminary Design. Preliminary Design Report. Volume I. Kawashige, C. M. (Aero-

jet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 254p. Dep. NTIS $15.75.

This volume of the NERVA Altitude Simulation System (NASS) Exhaust Duct System (EDS) preliminary design report contains: a discussion of the criteria documents used in developing the EDS preliminary design; information on NASS EDS conformance with design criteria; the NASS EDS preliminary bid package with drawings, specifications, schedules, and cost estimates; and required testing programs and preliminary design analyses. (LCL)

25736 (TID/SNA-818) RESEARCH SUMMARY REPORT ON LOGARITHMIC FORCE FEEDBACK WITH A FRICTION AND INERTIA REDUCING CONTROLLER FOR A SERVO MASTER-SLAVE SYSTEM. Matsueda, J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1971. 47p. Dep. NTIS $5.50.

The purpose of this study was to evaluate and demonstrate the effectiveness of exponential force amplification combined with logarithmic force feedback for potential application in advancing the state of teleoperator design. This research task supplements the current ANSC Teleoperator Study Program. The importance of this study was recognized when a review of existing teleoperator systems indicated a serious problem area in obtaining a sensible force feedback that would provide the operator with slave load/force perception over a reasonable load range. The following conclusions were drawn from the study: (1) employment of logarithmic force feedback in teleoperator control systems will greatly extend the load feel range of remotely operated servo master/slave manipulators; (2) the greatly improved load "feel sensitivity" in the small load regime should improve dexterity in gripping and delicate handling of fragile objects by an order of magnitude; (3) the high gain force feedback provided will certainly augment control of cross-coupling and interaction forces between various appendages; (4) logarithmic force feedback has an inherent flexibility, in that, by simple scaling or shifting of the scale, large variations in magnitude and range of force feedback can be obtained for a particular slave operator load range; and (5) it is recommended that the study of logarithmic force feedback be extended and that a program be initiated to apply the concept to a servo master/slave manipulator having several degrees of freedom so that the potential human adaptivity advantages in the regimes of dexterity and interaction control can be evaluated. (TFD)

25737 THE USE OF RADIONUCLIDES IN FRANCE FOR RADIOGRAPHY AND AS TRACERS. Le Huerou, M. (Compagnie Generale de Radiologie, 92—Issy-les-Moulineaux (France)). Kerntechnik; 16: No. 11, 494-495(Nov 1974).

Artificial radionuclides such as ^{192}Ir, ^{60}Co, ^{170}Tl, and ^{137}Cs are used for the nondestructive testing of welded joints and of castings, thus steadily increasing the reliability of quality control techniques. This method, called gamma radiography, has been steadily developed in France since 1950. New compact and very light devices, built in accordance with the Standard NF M 60.551, ensure full safety of use. (auth)

25738 SCINTILLOGRAPHY USING THERMAL NEUTRONS. Sinclair, K. F.; Zagorites, H. A.; Zimmermann, K. A. (Xetex, Inc., Redwood City, CA). Mater. Eval.; 33: No. 3, 56-60(Mar 1975).

From national fall conference of the American Society for Nondestructive Testing; Chicago, IL (1 Oct 1973).

Thermal neutron radiography has gained acceptance as a powerful new tool for nondestructive evaluation (NDE). For many applications, scintillography using thermal neutrons should be considered as an alternative to radiography. Neutron scintillography is a gaging technique in which the object is scanned by a finely collimated neutron beam; the transmitted intensity is measured by a scintillation detector (or combination of detectors) and displayed, typically, on a strip chart recorder. In this paper, the application of neutron scintillography to repetitive inspection tasks will be explored. Scintillography is not a new technique, but, until recently, practical systems have not appeared. Conceptually the method is straight-forward, involving only a radiation source, one or more high efficiency scintillation detectors, suitable collimation, and electronic processing and readout. Each of these areas is discussed and related to overall system design. Performance parameters including scan speed, neutron flux requirements, and sensitivity are related graphically and some applications are outlined. (auth)

25739 ULTRASONIC TESTING OF IRRADIATED FUEL SHEATHING. Patel, H. B.; Ditschun, A.; Hunton, A. E. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Mater. Eval.; 33: No. 3, 49-55(Mar 1975).

From national fall conference of the American Society for Nondestructive Testing; Chicago, IL (1 Oct 1973).

Zirconium alloy sheathing from nuclear fuel elements that had contained uranium dioxide fuel pellets irradiated to a burnup of 103 to 161 MWh/kg U (4290 to 6707 MWd/t) was tested, after removing loose pellets, by an ultrasonic pulse-echo technique using 15 MHz shear waves. The ultrasonic signals were correlated with metallographically observed defects. The results indicate that the test can detect irradiation-related primary incipient and secondary defects in the fuel sheathing. The test is capable of detecting defects having a depth as small as 10% of the 0.4 mm wall thickness. Tests on fuel elements containing uranium dioxide pellets indicate that sheath cracks can be detected ultrasonically even in the presence of cracked pellets. The ultrasonic test can be developed into a valuable aid in post-irradiation fuel examination by identifying regions for subsequent destructive examination. (auth)

25740 ACOUSTIC EMISSION FROM FLAWED HEAVY SECTION STEEL PLATES. Ying, S. P.; Grigory, S. C. (Southwest Research Inst., San Antonio). Mater. Eval.; 33: No. 2, 30-36 (Feb 1975).

In order to apply acoustic emission technology to safety inspections of pressure vessels and piping, basic acoustic emission data have been obtained from heavy section flawed steel specimens during tensile tests. When the emission rate is plotted as a function of applied stress or the corresponding value of strain, characteristically, the acoustic emission rate has a peak prior to the elastic limit. It was also found that the rate of change of emission with respect to strain depends on the test temperatures. The temperature dependence of acoustic emission is investigated by a theoretical model based on the theory of dislocations. (auth)

25741 ULTRASONIC ATTENUATION MONITORING OF FATIGUE DAMAGE IN NUCLEAR PRESSURE VESSEL STEEL AT HIGH TEMPERATURE. Joshi, N. R.; Green, R. E. Jr. (Johns Hopkins Univ., Baltimore). Mater. Eval.; 33: No. 2, 25-29(Feb 1975).

Ultrasonic attenuation measurements were made during fatigue cycling of steel specimens cut from a nuclear reactor pressure vessel, maintained at a temperature of 662°F, the normal inservice operating temperature of nuclear reactor pressure vessels. In a typical test, the ultrasonic attenuation initially remained constant, slowly decreased, decreased more rapidly, and then increased catastrophically just prior to fracture of the test specimen. Ultrasonic attenuation served as a very sensitive indicator of fatigue damage and indicated the eminence of fracture many hours before conventional ultrasonic testing could detect an additional ultrasonic pulse echo caused by waves reflected from a crack. The results indicate that the ultrasonic attenuation monitoring technique can be used to detect fatigue damage in nuclear reactor pressure vessels while the pressure vessel is in service at elevated temperature. (auth)

25742 NONDESTRUCTIVE INSPECTION: KEY TO NUCLEAR EQUIPMENT QUALITY. Rawlings, J. G. (Combustion Engineering Inc., Chattanooga, TN). Metal Progr.; 107: No. 3, 96-97 (Mar 1975).

Nondestructive examination (NDE) is discussed with respect to the inspection of pressure vessels. As presently employed in the nuclear industry, NDE can be broken down into two types—surface examination for cracks, porosity, and the like; and volumetric examination for internal flaws, such as slag inclusions, porosity, and lack of fusion. Surface examination calls for visual, dye penetrant, and magnetic particle inspections, while volumetric examination includes radiography, ultrasonic, and eddy current tests. (PMA)

25743 ACOUSTIC EMISSION TRANSDUCER CALIBRATOR. Leschek, W. C. (Westinghouse Research Labs., Pittsburgh). Mater. Eval.; 33: No. 2, 41-48(Feb 1975).

A method for calibrating an acoustic emission transducer is described. Calibration is performed by comparing the output signal of the acoustic emission transducer against that of a primary standard while both transducers are acoustically loaded by a medium which is representative of a large metal structure, such as a nuclear reactor pressure vessel wall, and are exposed to the same diffuse random noise sound field. The primary standard transducer is calibrated independently, using a reciprocity technique, in a gated continuous-wave sound field. (auth)

25744 PENETRATING RADIATION EXAMINING APPARATUS HAVING A SCANNING COLLIMATOR. Hounsfield, G. N. (to EMI Ltd.). US Patent 3,866,047. 11 Feb 1975. Priority Date 23 Aug 1968, United Kingdom of Great Britain and Northern Ireland. 14p.

Apparatus for examining a body by means of radiation such as x or γ radiation includes a source of radiation, means for directing the radiation along a group of spaced ray paths through a region of interest and toward detector located on the opposite side of the region to the source. Means are provided for reciprocating the collimator relative to the detector so as to cause the radiation to be scanned over said detector so that radiation directed through said body along a plurality of ray paths can be detected by a single detector. Means are also provided for orbiting the apparatus relative to the region of interest. (Official Gazette)

Nuclear Explosions

Refer also to abstracts 25768, 25791, 25918, 25937, and 25939.

25745 (AD-778100) NUMERICAL AND THEORETICAL STUDY OF THE RESPONSE OF HARD-MOUNTED EQUIPMENT. Final Report, 31 December 1972–30 December 1973. Schreyer, H. L.; Romesberg, L. E. (Mechanics Research, Inc., Los Angeles, Calif. (USA)). Mar 1974. Contract F29601-73-C-0053. 270p. (AFWL-TR-73-253). NTIS $16.50.

A numerical study was performed on the response of hard-mounted equipment in a frame structure subjected to a triangular pressure pulse. Two aspect ratios and two stiffnesses were considered for the frame which was restrained by soil modeled with oneway compressive springs. Point-mass and beam-type equipment was analyzed together with bilinear-elastic and elastic-plastic supports. Models for predicting the effects on equipment of stress waves in the structural walls were developed. A computer program was developed to model the non-linear material behavior. (auth)

25746 (AD-779933) SEISMIC WAVE PROPAGATION AND EARTHQUAKE CHARACTERISTICS IN ASIA. Semiannual Technical Report No. 1, 1 October 1973—31 March 1974. Kisslinger, C.; Engdahl, E. R.; Boucher, G.; Ganse, R. (Cooperative Inst. for Research in Environmental Science, Boulder, Colo. (USA)). 30 Apr 1974. Contract F44620-74-C-0015. 65p. (AFOSR-TR-74-0866). NTIS $3.75.

Three-dimensional seismic ray tracing leads to improved hypocenter locations and focal mechanism solutions. Relations of events to upper mantle structure to under the Aleutian arc are classified. Long-period P waves are very weak on HGLP seismograms of explosions, but long-period SV waves are seen. Long period body wave spectra can be used to fix the depth of crustal earthquakes. Body wave spectra, magnitudes, and focal mechanisms for events in seismic zones of central Asia have been determined. (auth)

25747 (NVO-152) CENTRAL NEVADA TEST AREA DEMOBILIZATION AND RESTORATION ACTIVITIES. Summary Report. (Holmes and Narver, Inc., Las Vegas, Nev. (USA). On-Continent Test Div.). Dec 1974. 61p. Dep. NTIS $5.45.

Demobilization and restoration activity at the Central Nevada Test Area (CNTA) through November of 1974 are reported. Although the CNTA is not completely demobilized and a final demobilization is not planned in the immediate future, recent site inspections made by Bureau of Land Management (BLM) personnel have tentatively resulted in the BLM's oral acceptance of demobilization work performed during the summer and fall of 1973. The purpose of this report is to: (1) identify the facilities, equipment, and materials that have been demobilized and the land areas that have been restored; (2) document the measures taken to plug, cap, or otherwise dispose of drilled holes; (3) identify land areas that have been returned to the BLM and Nye County; (4) indicate the facilities, land areas, materials, and supplies that remain; and (5) provide other pertinent data. (auth)

25748 (SAND-74-0252) FREE-FIELD GROUND MOTION INDUCED BY UNDERGROUND EXPLOSIONS. Perret, W. R.; Bass, R. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. AT(29-1)-789. 121p. Dep. NTIS $9.25.

Free-field ground motion induced by 60 contained underground nuclear explosions and one underground chemical explosion detonated by the U. S. Atomic Energy Commission at the Nevada Test Site and elsewhere was measured, and data from recorded motion have been collated and analyzed for effects of geologic environment on attenuation of the motion. These data include those derived from hydrodynamic, nonlinear, and linear response of the rock. This study involved nearly 1100 peak stress and motion data, of which 116 were of stress and particle velocities from within the hydrodynamic response region and the remainder were accelerations, particle velocities, and displacements from the nonlinear and beginning of the linear response regions. Data from the latter two regions included 183 in a dry alluvium environment, 198 in dry tuff, 215 in wet tuff, and 425 in hard rock, i.e., granite, salt, dolomite, and similar sedimentaries. Log-linear regression of these data normalized to explosive energy release equivalent to that of one kiloton of TNT for each motion parameter in each environment indicate such facts as no differentiation between dry alluvium, dry tuff, wet tuff, or granite, in particle velocities in the hydrodynamic response regime where stress is attenuated as the inverse 2.96-power of distance from the source and particle velocity as the inverse 1.87-power. Scaled accelerations are generally represented by two-branched attenuation in both the nonlinear and linear domains, but except for dry alluvium this appears to become a single attenuation pattern in the other motion parameters. Scaled accelerations and particle velocities are of similar magnitude in saturated tuff and hard rock but are lower in dry tuff and still lower in alluvium. Scaled displacements are of roughly similar amplitude except in dry alluvium where they are lower by factors ranging from 5 to 10. Analysis of all particle velocities from the hydrodynamic region and from wet tuff and hard rock in the nonlinear region shows a single linear trend over a range of 5 orders of magnitude, for which the regression equation is $u = 1.85 \times 10^4 (R/W^{1/3})^{-1.76 \pm 0.02}$ where u is particle velocity in meters per second and $R/W^{1/3}$ is scaled radial range in meters per cube-root yield in (kilotons)$^{1/3}$. (auth)

25749 (SAND-75-8227) PLOWSHARE PROGRESS REPORT FOR QUARTER ENDING DECEMBER 31, 1974. (Sandia Labs., Livermore, Calif. (USA)). Feb 1975. Contract AT(29-1)-789. 5p. Dep. NTIS $4.00.

Progress during the period from Oct. 1 through Dec. 31, 1974 in the Plowshare Project is reported. Information is included on the development of high-temperature arming and firing components, design of control switches, plans for destruct systems, and improvement in the protection afforded by the safe-secure trailers (LCL)

25750 SAFETY PROBLEMS IN THE USE OF UNDERGROUND NUCLEAR EXPLOSIONS. Schulze, H. (Brennstoffinstitut, Freiburg i.B.). Mitt. Brennstoffinstit. Freiberg; 4: No. 6, 29-37(1973). (In German).

A literature survey on the peaceful uses of underground nuclear explosions is given covering the period 1971 to 1973. The following topics are discussed: environmental and product contamination in gas stimulation and recovering oil from oil shale, seismic effects of contained explosions, and European aspects of cavity production for the storage of gases or liquids. (auth)

Protective Structures and Equipment

25751 (ORNL-tr-2918) ADSORPTION CHARACTERISTICS OF VARIOUS FILTERS FOR GASEOUS IODINE. Vogt, K. J.; Meringdal, J. (Oak Ridge National Lab., Tenn. (USA)). Mar 1966. Translated by H. Buchholz from a German paper. 37p. Dep. NTIS $5.00.

Several active charcoal filters (active charcoal granule cartridges, active charcoal paper filters, aerosol filters containing active charcoal powder) were investigated with respect to their absorption probability for gaseous iodine (I_2). An exponential relationship between the penetration of the filter and the weight density of the active charcoal was found. The mass adsorption coefficient is an exponential function of the gas velocity at the filter. Adsorption capacity and decrease in filtration efficiency were measured as functions of preloading with iodine or adsorbable foreign gases. All filters investigated were suitable as test filters in air control. Active charcoal may also be used in cleaning filters, if they are properly designed. The results of these investigations permit one to evaluate the optimum active charcoal weight density, the diameter of the filter, the gas velocity, the volumetric air flow and the filter life time. In order to obtain a high adsorption capacity in heavy polluted air, the air should be filtered in granule cartridges containing a sufficient amount of active charcoal. Aerosols should be deposited on a prefilter. Filter tape devices give some advance in the control of the contamination of the air, for instance the free atmosphere. Normal filter devices, e.g., step filter (28), can be made efficient in iodine control by loading the absolute filter with active charcoal (aerosol filter tapes are in development). The active charcoal paper filter No. 508 and 509 made by Schleicher u. Schull are not produced in the right length necessary in filter tape devices. They are only useful in fixed filter devices. (auth)

25752 GLOVE BOXES. Dimensions and Requirements. pp DIN-25412 B1.1 of German Norms. Draft. Berlin, F.R. Germany; Beuth (Jun 1974). (In German).

12 figs.; 2 tabs.

This draft standard refers to the construction of glove boxes, how they have developed after over 10 y of development by industry and the big research centers on the basis of practical experience. (GE)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstract 25271.

25753 (AEC-tr-7604) OKLO PHENOMENON. Translated by I. Leonard from Bull. Inform. Sci. Tech. (Paris); No. 193, 1-86 (1974). 222p. Dep. NTIS $14.25.
Separate citations are included for each of the five papers translated. (MCG)

For references to individual papers see: 25754–25758.

25754 (AEC-tr-7604, pp 4-126) NATURAL REACTORS IN OKLO. Summary of Research Through May 1, 1974. Naudet, R. (CEN, Saclay, France). Dec 1974. Translated by I. Leonard from Bull. Inform. Sci. Tech. (Paris): No. 193, 7-45(1974).
In Oklo phenomenon.

25755 (AEC-tr-7604, pp 127-131) SOME OBSERVATIONS MADE AT THE OKLO DEPOSIT IN THE "REACTOR ZONES". Weber, F. (CNRS, Strasbourg). Dec 1974. Translated by I. Leonard from Bull. Inform. Sci. Tech. (Paris): No. 193, 47-49 (1974).
In Oklo phenomenon.

25756 (AEC-tr-7604, pp 132-157) MICROSCOPIC STUDY OF OKLO URANIUM-BEARING ORES. Geffroy, J.; Lissillour, J. (CEN, Fontenay-aux-Roses, France). Dec 1974. Translated by I. Leonard from Bull. Inform. Sci. Tech. (Paris): No. 193, 51-58 (1974).
In Oklo phenomenon.

25757 (AEC-tr-7604, pp 158-165) STUDY OF IRRADIATION DAMAGE AND URANIUM MICRODISTRIBUTION IN SAMPLES FROM THE OKLO DEPOSIT. Dran, J. C. (CNRS, Orsay, France); Maurette, M.; Duraud, J. P. Dec 1974. Translated by I. Leonard from Bull. Inform. Sci. Tech. (Paris): No. 193, 59-63 (1974).
In Oklo phenomenon.

25758 (AEC-tr-7604, pp 198-206) ISOTOPIC ANALYSIS OF RARE EARTHS IN THE ORE OF THE OKLO FOSSIL REACTOR. Neuilly, M.; Dozol, J. F. (CEN de Cadarache, St.-Paul-les-Durance, France). Dec 1974. Translated by I. Leonard from Bull. Inform. Sci. Tech. (Paris): No. 193, 77-80(1974).
In Oklo phenomenon.

25759 (NP-20301) GEOLOGICAL-GEOPHYSICAL INTEGRATION OF RADIOMETRIC DATA. Purata, J. M. B. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria). 1974. 140p. (In Spanish). Dep. NTIS (US Sales Only) $10.00.
Thesis.
The principal problem in the exploration of natural resources is the determination of promising sites. An attempt is made to develop the basic physical and geological principles for the processing and interpretation of radiometric data so as to localize the search for radioactive minerals. Favorable conditions and environments for the deposition of U are outlined. The methods used in the acquisition and processing of geophysical data are described. (JSR)

25760 (ORNL-tr-2891) OBSERVATIONS MADE IN THE "REACTOR ZONE" OF THE OKLO DEPOSIT. Weber, F. Translated by Martha Gerrard from Bull. Inform. Sci. Tech. (Paris); No. 193, 47-50(Jun 1974). 3p. Dep. NTIS $4.00.
The deposit is described under the following headings: general, intermediate conglomerate, enclosing pelites, tectonite, localization of uranium-bearing mineralization outside the reaction zones, reaction zones, and organic matter and mineralizations. (MCG)

25761 SPECTROSCOPIC STUDY OF OXONIUM IONS IN MINERALS. Wilkins, R. W. T. (Univ. of Queensland, St. Lucia, Australia); Mateen, A.; West, G. W. Amer. Sci.; 59: No. 7-8, 811-819(1974).
Nuclear magnetic resonance (NMR) and infrared spectroscopic studies of some mineral species in which the presence of oxonium ions has been postulated show that it is often difficult to obtain direct evidence of their existence. Clear evidence of oxonium in synthetic hydrogen uranospinite, $H_3O(UO_2AsO_4) \cdot 3\ H_2O$, was obtained by infrared spectroscopy. It was not possible either to confirm or disprove the existence of oxonium in synthetic members of the alunite-jarosite group by infrared spectroscopy. Although fine structure characteristic of the presence of oxonium was not obtained in NMR spectra of the uranyl arsenates or alunites, a comparison of 77 and 298°K spectra for different species revealed a degree of nonvibrational motion in some or all of the protons at room temperature. (auth)

25762 PHASE TRANSITION IN SYNTHETIC TROEGERITE AT ROOM TEMPERATURE. de Benyacar, M. A. R.; de Abeledo, M. E. J. (Comision Nacional de Energia Atomica, Buenos Aires). Amer. Sci.; 59: No. 7-8, 763-767(1974).
A reversible phase transition from a tetragonal (high temperature) to a low symmetry (low temperature) form was observed in synthetic troegerite ($H_2(UO_2)_2(AsO_4)_2 \cdot 8\ H_2O$). Observed transition temperature ranges from 18 to 28°C. Under the influence of a strong electric field the transition temperature decreases. DTA curves show an endothermic peak in the vicinity of 25°C; no dehydration occurs since TGA curves show no weight loss up to 85°C. If the tetragonal crystals are slowly cooled past the transition temperature, the low temperature form becomes visible as sets of anisotropic domains and sub-domains in the optically isotropic basal plates. Domains probably arise as a result of the asymmetric distortion of the lattice accompanying the transformation from the tetragonal to the low symmetry form on cooling. Despite the biaxial optics, precession films of the twinned crystals showed a geometrically tetragonal cell and no evidence of twinning. (auth)

25763 URANIUM-VANADIUM DEPOSITS OF THE THOMPSONS AREA, GRAND COUNTY, UTAH, WITH EMPHASIS ON THE ORIGIN OF CARNOTITE ORES. Stokes, W. L. Salt Lake City, UT; Univ. of Salt Lake City (Dec 1952). 51p. $1.00.
The Thompsons area of about 200 square miles occupies most of the northeast flank of the Salt Valley anticline in north-central Grand County, Utah. Exposed sedimentary rocks include the Navajo, Carmel, Entrada, Summerville, Morrison, Cedar Mountain, Dakota, and Mancos formations. The Morrison formation, which contains the ore deposits, consists of a lower unit, the Salt Wash sandstone member and an upper unit, the Brushy Basin shale member. Paleontology, paleogeography, and lithologic features of the Morrison formation indicate a fluvial origin on an aggrading flood plain. The ore bodies consist of a concentration of various uranium and vanadium minerals in sand lenses. Most of the ore minerals occupy pore spaces in the sandstone. The largest and richest ore bodies are elongate and crudely semicylindrical "rolls" that occur in groups in the sand lenses. Studies of cross-bedding in the area show that the long axes of rolls are parallel to the direction of flow of the water that deposited the enclosing sandstone. The ore is nearly always accompanied by organic material of some kind, by limonite staining in associated sandstones, and by blue-green color alterations in the mudstones below the deposits. It is assumed that the ore minerals were deposited from ground water in the vicinity of decaying organic materials shortly after the enclosing sandstones accumulated. As organic material seems to be essential to ore formation, considerable attention has been given to factors that favor the accumulation of plant material on flood plains. It is concluded that the edges of thicker sand channels, especially along meander curves, are favorable sites for plant accumulation and hence for the formation of ore deposits. (auth)

Radioactive Effluents

Refer also to abstracts 25271, 25348, and 26502.

25764 (AECL-5011) ENERGY FOR TOMORROW: NUCLEAR POWER AND THE ENVIRONMENT. Barry, P. J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1974. 22p. (CONF-740744-1). Dep. NTIS (US Sales Only) $4.25. AECL $1.00.
From 1st world congress of environmental medicine and biology; Paris, France (1 Jul 1974).
It has been argued that the Pu required to fuel a future large-scale power generation system based on nuclear fission constitutes an unacceptable danger to the health of the world population. In this paper, an upper limit of the dose commitment to the world population following a release as an aerosol to the atmosphere of 4×10^5 tonnes of ^{239}Pu is shown to be limited to less than ten times the maximum dose commitments recommended workers by the International Commission on Radiological Protection (ICRP). Since this quantity of Pu is roughly the entire working inventory required to sustain a global nuclear power generation rate of 3×10^{11} kW(t), the actual dose commitment from real releases of Pu to the global environment must be very

considerably lower. It is argued then that, compared to the potential benefit of being able to supply a future world population of 15×10^9 with 20 kW(t) of energy per capita, the risks of incurring serious radiation damage to that population are very low. (auth)

25765 ELECTRIC CHARGES OF BETA-RADIOACTIVE HOT AEROSOL PARTICLES IN TURBULENT FLOW. Kirichenko, V. N.; Suprun, N. N. Dokl. Akad. Nauk SSSR; 215: No. 2, 325-328 (11 Mar 1974). (In Russian).

Micron-size particles suspended in the atmosphere with a sufficiently high individual β activities of 10^{-11} Ci and higher spontaneously acquire positive electrical charges of the order of several hundred elementary charges. A theoretical calculation was made of the size of their steady charge in turbulent flow, i.e., in conditions very close to those occurring in industrial and free atmosphere. The calculations show that the size of the steady positive charge acquired by hot particles in turbulent flow lies in the region from 10^2 to 10^5 elementary charges. (JSR)

Radioactivity Monitoring and Transport

Refer also to abstract 25348.

25766 (BNWL-1716) TRANSPORT MODEL USER'S MANUAL. Ahlstrom, S. W.; Baca, R. G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-2130. 125p. Dep. NTIS $5.45.

The Transport Model code consists of three main programs, TRACK, MICRO and MACRO. This document describes procedures for accessing these programs, inputting data to them, and interpreting the output that is generated. (auth)

25767 (CNEA-376) RADIOACTIVE FALLOUT DUE TO ATMOSPHERIC TESTS IN SOUTH PACIFIC IN THE PERIOD 1971-1972. Beninson, D.; Migliori de Beninson, A.; Menossi, (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 12p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

As a result of the systematic environment monitoring, the contamination levels in Argentina due to short and intermediate half-live radionuclides in the environment during 1971 and 1972 are presented. The population dose commitment was estimated as 3.0 mrad due to external radiation and 8 mrad in thyroid. (auth)

25768 (NVO-410-29) ONSITE ENVIRONMENTAL SCIENCES ACTIVITIES DURING THE BANEBERRY EVENT. Roy, T. C.; Eubank, B. F. (comps.). (Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nev. (USA)). Jun 1973. Contract AT (26-1)-410. 58p. Dep. NTIS $5.45.

Environmental monitoring activities during the BANEBERRY test at the Nevada Test Site on December 18, 1970, are described. Pertinent operational activities from before zero time through completion of sample drilling are detailed and explained. Personnel exposures, air, soil, water, and bioassay analysis results are defined and listed. Monitoring, area control, decontamination, and area restoration activities are documented and appendices of radiation guides, telemetry station locations, isoplesh contours, support plans, dose calculations model, air, soil, and water sample results are provided. (auth)

25769 (RLO-2227-T12-48) RADIOACTIVE ZINC (^{65}Zn), ZINC, CADMIUM, AND MERCURY IN THE PACIFIC HAKE, MERLUCCIUS PRODUCTUS (AYRES), OFF THE WEST COAST OF THE UNITED STATES: A DATA REPORT. Naidu, J. R.; Cutshall, N. H. (Oregon State Univ., Corvallis (USA). School of Oceanography). Aug 1974. Contract AT(45-1)-2227. 52p. Dep. NTIS $5.75.

Results of analyses of several hundred Pacific hake for ^{65}Zn, Zn, Cd, and Hg are presented in the form of tables. Procedures are described for collection and storage of fish, preparation of samples, analytical methods, and intercalibrations. (HLW)

25770 PROBABILITY NATURE OF RADIONUCLIDE ACCUMULATION AND ACTION IN SEA WATER. Ivanov, V. N.; Parchevskaya, D. S. (Inst. of Biology of the South Seas, Sevastopol, USSR). Dokl. Akad. Nauk SSSR; 218: No. 1, 215-218(1 Sep 1974). (In Russian).

The variability of the indicators characterizing the adsorption properties of radionuclides, the accumulation of radioactivity by individual hydrobionts, and the expression of the radiobiological effects were studied from a probability approach. The experimental results reported on the accumulated activity of ^{59}Fe and ^{91}Y in fish eggs as a function of the age of the solution and the chromosome aberrations follow probability curves. These results confirm the validity of the probability approach to the study of the processes of adsorption, accumulation, and effects of radionuclides in seawater. (JSR)

Atmosphere

Refer also to abstract 25844.

25771 (COM-74-11336/6) PROGRAM FOR EVALUATING ATMOSPHERIC DISPERSION FROM A NUCLEAR POWER STATION. Technical Memo. Sagendorf, J. F. (National Oceanic and Atmospheric Administration, Idaho Falls, Idaho (USA). Air Resources Lab.). May 1974. 18p. (NOAA-TM-ERL-ARL-42). NTIS $3.00.

A computer code (SEP for Site Evaluation Program) is described. The program uses a joint frequency distribution of winds and stability classes to evaluate the atmospheric dispersion potential near a nuclear power station. The code includes models for short-term and long-term effluent releases. A description of the input parameters is included. (GRA)

25772 RADIOISOTOPES AND GLOBAL TRANSPORT IN THE ATMOSPHERE. Karol, I. L. Jerusalem; Keter Publishing House (1974). 336p. (TT-74-50025). NTIS.

Translation of Radioaktivnye izotopy i global'nyi perenos v atmosfere, Gidrometeoizdat, Leningrad, 1972.

Separate abstracts were prepared for the eight chapters. (CH)

For abstracts of individual chapters see: 25773-25777 and 25788-25790.

25773 MODEL OF GLOBAL RADIOISOTOPE TRANSPORT IN THE TROPOSPHERE AND LOWER STRATOSPHERE. Fundamental Equations and Boundary Conditions. pp 44-78 of Radioisotopes and Global Transport in the Atmosphere. Karol, I. L. Jerusalem; Keter Publishing House (1974).

A mathematical model of the transport of fallout radioisotopes in the troposphere and lower stratosphere is described that uses a series of assumptions to derive and simplify fundamental equations and boundary considerations that quantitatively describe the processes involved in global distribution. (CH)

25774 VERTICAL TRANSPORT AND REMOVAL OF RADIOACTIVE AEROSOLS IN THE ATMOSPHERE: QUANTITATIVE MODELS OF AEROSOL WASHOUT BY PRECIPITATION AND DRY DEPOSITION ON THE UNDERLYING SURFACE. pp 79-126 of Radioisotopes and Global Transport in the Atmosphere. Karol, I. L. Jerusalem; Keter Publishing House (1974).

Quantitative models of the vertical transport of fallout radioisotopes and the removal of radioactive aerosols in the troposphere are reviewed. Estimates are given for the rates of removal of radioisotopes from the ground level layer of the atmosphere by dry deposition and seasonal variations in precipitation washout at various geographical locations. Equations are presented for the vertical dissipation of containment concentration in the boundary layer of the atmosphere. (CH)

25775 DIFFERENCE ANALOGUES OF BOUNDARY-VALUE PROBLEMS FOR THE EQUATIONS OF GLOBAL RADIOISOTOPE CONTAMINANT TRANSPORT AND THEIR NUMERICAL SOLUTION: DIFFERENCE APPROXIMATION OF EQUATIONS AND BOUNDARY CONDITIONS IN THE MERIDIONAL PLANE AND THE ZONAL BELT OF THE ATMOSPHERE. pp 167-184 of Radioisotopes and Global Transport in the Atmosphere. Karol, I. L. Jerusalem; Keter Publishing House (1974).

Mathematical models of global fallout radioisotope transport are reviewed and equations are presented for use in calculations of the effects of the boundary layer on mixing in the meridional plane and the zonal belt of the atmosphere. (CH)

25776 SPREAD OF RADIOACTIVE PRODUCTS OF SERIES OF POWERFUL NUCLEAR BLASTS IN A MERIDIONAL PLANE OF THE ATMOSPHERE: PARAMETERS OF THE NONSTEADY BOUNDARY-VALUE PROBLEM OF CALCULATING THE ZONAL MEAN CONCENTRATION AND FALLOUT OF NUCLEAR BLAST PRODUCTS. pp 221-275 of Radioisotopes and Global Transport in the Atmosphere. Karol, I. L. Jerusalem; Keter Publishing House (1974).

Observations made with meteorological balloons and results of sampling of radioactive clouds from nuclear explosions indicate that air masses in the upper troposphere and lower stratosphere circle the earth within two to four weeks in the temperate zone. Calculations were made of the time required for the global diffusion of fallout fission products following nuclear explosions in the atmosphere in tropical, temperate, and arctic latitudes of the northern hemisphere. The calculated values are compared

with measured values of fallout radioisotope distributions following release to the atmosphere during weapons tests. The influence of uncertainties in the altitude of the explosion and energy of the blast on parameters of actual measurements are discussed. (CH)

25777 PLANETARY FIELDS OF COSMOGONIC ISOTOPE CONCENTRATION IN THE TROPOSPHERE AND LOWER STRATOSPHERE: PARAMETERS OF THE BOUNDARY-VALUE PROBLEM OF COMPUTING THE ZONAL MEAN CONCENTRATION OF COSMOGONIC ISOTOPES. pp 276-300 of Radioisotopes and Global Transport in the Atmosphere. Karol, I. L. Jerusalem; Keter Publishing House (1974).

The physics and quantitative features of the formation of cosmogenic isotopes in the atmosphere at various geomagnetic latitudes are briefly reviewed. The advantages of using cosmogenic ^{22}Na, ^{32}P, and ^{33}P to measure atmospheric movements on a planetary scale are discussed. Seasonal and latitudinal variations in deposition of cosmogenic isotopes in fallout are discussed. Methods used in estimating the total content of cosmogenic isotopes in the stratosphere, troposphere, and in fallout and their transport across the equator are described. (CH)

Soil

25778 RADIOACTIVE CONTAMINATION OF HUNGARIAN SOILS. Kalmar, T. (National Inst. for Agricultural Quality Testing, Budapest). Agrokem. Talajtan; 23: No. 3-4, 351-360 (Nov 1974). (In Hungarian).

In 72 soil samples collected in different parts of the country during 1971 to 1972 the ^{90}Sr contamination (pCi/kg) was measured. The sampling places were selected according to soil types and land use on the areas surveyed by our Institute. The samples were taken from the upper 5 cm layers of the different soil types on both cultivated and non-cultivated areas (meadows, pastures). The samples were treated with hydrochloric acid and the Sr content was separated with oxalic acid; the activity of the ignited precipitate was measured using 100 pCi ^{90}Sr as standard. The pH values, the amount of $CaCO_3$, the humus percentage, the Ca content of the HCl extract and the particle size distribution were also determined in the samples. As regards territorial distribution, the activity values were the lowest in the samples collected in Transdanubia and in the region between the rivers Danube and Tisza. In the case of 38 samples we studied the relationship between radioactive contamination and certain soil properties. When comparing, in the case of a given soil type, the ^{90}Sr contamination of cultivated and non-cultivated areas, statistical evaluation revealed significant differences: ^{90}Sr fixation by non-cultivated soils was higher. In respect to the relationship between contamination and particle size distribution, ^{90}Sr fixation by light textured soils (coarse sand) was less than by heavy loams. Due to the deviation of the data it was only in the cases of loamy soils with 41 to 60% physical clay content that a correlation could be established. Though to a lesser extent, the $CaCO_3$ content of the soils plays also a certain role in ^{90}Sr fixation. In soils with higher calcium content, the average values of contamination were higher. Apart from some extreme data, the ^{90}Sr contents of the soil samples examined in 1971 to 1972 varied generally between 100 and 350 pCi/kg. These values do not exceed those measured in different parts of Europe. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 25230, 25791, and 26207.

25779 (BNWL-1879) ECOLOGICAL BEHAVIOR OF PLUTONIUM AND AMERICIUM IN A FRESHWATER ECOSYSTEM. Phase II. Implications of Differences in Transuranic Isotopic Ratios. Emery, R. M.; Garland, T. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1974. Contract AT(45-1)-1830. 29p. Dep. NTIS $4.00.

The ecological behavior of Pu and Am in a freshwater processing waste pond has been studied since July 1973 to characterize the pond's limnology and define the isotopic distributions in this ecosystem. Results from this study show that the history of transuranics discharged to the pond has created a complex combination of source terms and isotopic ratios. Since these source terms and chemical forms entering the pond have not been clearly defined, a material balance for Pu and Am in this ecosystem cannot be developed. Relatively large quantities of ^{238}U have been released to the pond, and these, along with unidentified levels of ^{232}Th and ^{228}Th create a problem of interpreting the ecological behavior of Pu and Am in this ecosystem. Ratios of ^{238}Pu to $^{239,240}Pu$ found in the pond are much higher than those in the processing wastewaters released to the pond. Ratios of ^{238}Pu to $^{239,240}Pu$ and ^{241}Am to $^{239,240}Pu$ are significantly higher in the pond biota (plants, invertebrates, fish) than in the sediments, suggesting a common source of availability to the biota. This contention is supported by the rapid establishment of these ratios in goldfish (Carassius) which were experimentally introduced into the pond. Ratios of ^{241}Am to ^{238}Pu in the pond biota are also significantly different from those of the sediments but to a lesser degree than ratios of ^{238}Pu to $^{239,240}Pu$ and ^{241}Am to $^{239,240}Pu$. A wide range of particle sizes of ^{238}Pu and $^{239,240}Pu$ may exist in the pond sediments. The pond sediments, however, may not be the major source of available Pu and Am because results of this study suggest that sediments in a trench carrying the processing wastes to the pond may be the primary source. (auth)

25780 (ZAED-BIBL.-02-14) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 02: Contamination and Decontamination of Foods. Number 14. Fischer, E. (comp.). (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Nov 1974. 32p. (In German and English). Dep. NTIS (US Sales Only) $4.75.

References are presented to publications during 1971 to 1973 on the contamination of foods by radioisotopes and the transport of radioisotopes through food chains to man. Author, report number, and subject indexes are included. (CH)

25781 CONTAMINATION OF SOILS BY INDUSTRIAL RADIOACTIVE WASTES. Mechanisms and Factors of Migration and Evolution. Saas, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Service de Recherches Toxicologiques et Ecologiques). Sci. Sol.; No. 4, 255-264(1973). (In French).

A number of examples are given illustrating the investigations on soil protection carried out by the laboratory of continental radioecology. The techniques of soil and radionuclide migration are first reviewed: the main trends of investigations are then developed: role of the radionuclide vector in the soils, influence of the mode of entry of the radionuclide in the biological cycles, influence of some specific soils compounds, in particular organic matter. The aim of these applied investigations is to demonstrate the main mechanisms involved in the transfer of radionuclides to the soils and their uptake by plants. (FR)

Radiometric Techniques

Refer also to abstracts 25759, 25772, 25776, 25912, 25914, 25916, and 25950.

25782 (COO-3222-04) NITROGEN METABOLISM IN THE SEA. Final Report. Harris, V.; Roels, O. A. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory). 31 Dec 1974. Contract AT(11-1)-3222. 10p. Dep. NTIS $4.00.

Studies were conducted on the measurement of the rate and efficiency of nitrogen transfer from the first to the second trophic level, or from the producer to the primary consumer level. Nitrogen transfer was measured from phytoplankton to zooplankton in the natural marine environment using ^{15}N-labeled phytoplankton as a tracer and a large-volume experimental container as a means of maintaining the natural community during the course of the experiment. (HLW)

25783 DEUTERIUM CONTENT OF HUMIC ACIDS FROM MARINE AND NON-MARINE ENVIRONMENTS. Nissenbaum, A. (Weizmann Inst. of Science, Rehovot, Israel). Mar. Chem. (Amsterdam); 2: No. 1, 59-63(Apr 1974).

Deuterium values obtained for humic acids isolated from marine sediments from the NE Pacific are in the range of $\delta D = (-105 \pm 5)$ ‰ corresponding to values obtained for marine plankton from the same area. Soil humic acids have a much broader range of δD values (−57 to −97 ‰), depending on the isotopic values of the precipitation and the isotopic composition of the parent plant precursor. Data obtained on hydrogen isotope distribution confirms previous hypotheses based on the chemical analysis and on carbon isotopes, which indicated the authigenic nature of marine humates. (auth)

25784 NEUTRON-ACTIVATION XENON-URANIUM METHOD FOR THE DETERMINATION OF THE AGE OF RADIOACTIVE MINERALS. Shukolyukov, Yu. A.; Ashkinadze, G. Sh.; Komarov, A. N. (Inst. of Geology and Pre-Cambrian Geochronology, Leningrad). Dokl. Akad. Nauk SSSR; 219: No. 4, 952-954(1 Dec 1974). (In Russian).

A new method of age determination is described which does not require the determination of the absolute quantity of radioactive and radiogenic isotopes. It is based on the isotopic analysis of xenon released from the mineral. The principles of the method and the first experimental results obtained are reported. (JSR)

25785 GROUNDWATER INVESTIGATION IN THE IRAQI WESTERN DESERT (Al-Mat Area) USING NUCLEAR TECHNIQUE.

Al-Badri, A. S. (Nuclear Research Inst., Baghdad). Nucl. Technol.; 25: No. 3, 580-584(Mar 1975).

Four boreholes were drilled in the Iraqi Western Desert area, and many isotope injection experiments were carried out to determine the effective porosity, permeability, transmissibility, storage coefficient, and velocity of the underground water flow using ^{131}I as a radioactive tracer. The results indicate that the critical hydrological parameters (effective porosity, permeability, transmissibility, and storage coefficient) of the aquifer and the quantity of the water are adequate to provide sufficient high-quality water suitable for economic utilization. The radioactive technique used in drawdown for permeability, transmissibility, and storage coefficient measurements is specific and gave good results, whereas the classical method might be subject to technical operation errors. (auth)

25786 RADIOACTIVE AND ISOTOPIC AGE DETERMINATIONS OF UTAH ROCKS. Whelan, J. A. (comp.). (Univ. of Utah, Salt Lake City). Bull. Utah Eng. Exp. Sta.; No. 135, 1-75(Apr 1970).

Eleven lead-alpha age determinations made at the University of Utah, 14 isotopic K–Ar and Rb–Sr made by other laboratories in cooperative projects with the University of Utah, and 5 K–Ar age determinations as an award by Geochron Laboratories to G.M. Park as part of a graduate study program, and ages by other laboratories published prior to this report are too sparse to determine a period of maximum intrusive and extrusive activity within Utah. They suggest, however, the absence of Cretaceous intrusive activity, the association of beryllium-uranium-fluorite mineralization with intrusive and extrusive rocks of granitic composition 25 million years (m.y.) old or less, and a broad correlation between copper-lead-zinc mineralization and intrusives slightly more basic than granites and having an age of 30 to 50 m.y. The oldest Precambrian rock in Utah is the Raft River granite which is 2.4 billion years (b.y.) old. The Precambrian of the central Wasatch Mountains is 1.6 b.y. old but has a 550 m.y. thermal event imposed upon it. Furthermore, it is possible that a thermal event affected the Precambrian of Antelope Island 224 m.y. ago. (auth)

25787 Sr ISOTOPE RATIOS OF THE ALBERT BASALT-IMPLICATIONS IN THE PETRO-GENESIS OF THE FOCAL PEAK SHIELD VOLCANO, SOUTHEAST QUEENSLAND, AUSTRALIA. Ross, J. A.; Iyer, S. S. (Queensland Univ., St. Lucia, Australia). Curr. Sci. (India); 44: No. 6, 190-191(20 Mar 1975).

The ratio $^{87}Sr/^{86}Sr$ was measured for samples from the Albert Basalt. The ratios obtained are comparable to those of continental alkali basalts and slightly higher than those normally expected for oceanic alkali basalt. Possible reasons for this variation are discussed in relation to the petrogenic history of the shield volcano. (JSR)

25788 OBSERVED GLOBAL FIELDS OF RADIOISOTOPE CONCENTRATION IN THE ATMOSPHERE. Their Variation in Time and Space. pp 1-43 of Radioisotopes and Global Transport in the Atmosphere. Karol, I. L. Jerusalem; Keter Publishing House (1974).

Data are reviewed on the distribution of natural and fallout radionuclides in the atmosphere and the geophysical causes of observed distributions of radioisotope concentrations in the environment are discussed. Applications of atmospheric radioisotopes as tracers to study the transport and exchanges of air masses on a planetary scale with special references to long-range weather forecasting are summarized. (CH)

25789 PLANETARY DISTRIBUTION OF ZONAL MEAN TRANSPORT PARAMETERS OF RADIOISOTOPES IN THE TROPOSPHERE AND LOWER STRATOSPHERE: CLIMATIC DISTRIBUTION OF THE ZONAL MEAN COMPONENTS OF THE MERIDIONAL CIRCULATION VELOCITY. pp 127-166 of Radioisotopes and Global Transport in the Atmosphere. Karol, I. L. Jerusalem; Keter Publishing House (1974).

The distribution of zonal mean components of the meridional circulation of air masses and the effects of large-scale turbulent diffusion on the mixing velocity in the troposphere and lower stratosphere are discussed. Measurements of seasonal variations made using fallout radioisotopes as tracers are described. (CH)

25790 PLANETARY FIELDS OF CONCENTRATION OF RADON AND ITS LONG-LIVED DECAY PRODUCTS IN THE TROPOSPHERE AND LOWER STRATOSPHERE: PARAMETERS OF THE BOUNDARY-VALUE PROBLEM OF COMPUTING THE PLANETARY FIELDS OF THE RADON-SERIES ISOTOPE CONCENTRATION. pp 185-220 of Radioisotopes and Global Transport in the Atmosphere. Karol, I. L. Jerusalem; Keter Publishing House (1974).

Planetary distributions of ^{222}Rn and daughter isotopes (^{210}Pb, ^{210}Bi, and ^{210}Po) in the troposphere and lower stratosphere are discussed. It is pointed out that the distribution is essentially three dimensional since the continents are the source of Rn. The concentration of ^{222}Rn and daughter isotopes decreases with increasing altitude. Equations are presented for use in calculations of the effects of precipitation washout and the boundary layer on the isotope concentration at various levels. It is concluded that the Rn-series isotopes are not suitable for use in estimating the rate of exchange of air masses between the troposphere and lower stratosphere. (CH)

Site Surveys

Refer also to abstracts 25350–25352.

25791 (BMI-171-158) BIOENVIRONMENTAL AND HYDROLOGIC STUDIES, AMCHITKA ISLAND, ALASKA. Fall, 1974 Task Force Report. Kirkwood, J. B. (comp.). (Battelle Columbus Labs., Ohio (USA)). Feb 1975. Contract AT(26-1)-171. 48p. Dep. NTIS $5.45.

Bioenvironmental and hydrologic studies at Amchitka, Alaska have been conducted since 1967 when the Island was selected as the site for a series of underground nuclear weapons tests. At first these studies involved collecting data needed to predict the effects of nuclear testing activities and to recommend measures for minimizing adverse effects. After the final test on November 6, 1971, the studies were confined to measuring and evaluating these effects. This report presents the findings of a scientific field party visiting Amchitka during the period August 26 through September 4, 1974. The findings showed that the landscape that was modified by the Milrow and Cannikin nuclear tests was continuing to undergo natural changes. The hydrologic study involved measurements of water levels and stream flows at numerous locations. Cannikin Lake continued to undergo natural changes. Exceptionally large fish (Dolly Varden) were collected in Cannikin Lake, probably due to good growth rates of fish that were transplanted from other lakes. The spawning run of pink salmon in the 20 streams surveyed was smaller than expected. Reasons for the smaller runs might include previous construction activities in one area, siltation in a few areas, harvesting, predation by eagles, commercial fishing, and weather conditions. Recolonization of uplifted intertidal bench by algal and invertebrate communities continued to advance. The radioactivity survey revealed that maximum levels of radioactivity at Amchitka remain comparable to background levels in other areas of the United States. (CH)

25792 (BNWL-1876, pp 73-75) CHARACTERIZATION OF 300 AREA AND WYE BURIAL GROUNDS. Eliason, J. R. Nov 1974.

In nuclear waste management and transportation quarterly progress report, July–September 1974.

This study was designed to evaluate and define the present status of waste materials disposed to the 300 Area and Wye burial grounds and to evaluate the alternatives of designating the sites for permanent storage and/or removal of all or part of the materials. (auth)

25793 (TEI-840) SUMMARY OF THE GROUND-WATER HYDROLOGY OF THE AREA BETWEEN THE LAS VEGAS VALLEY AND THE AMARGOSA DESERT, NEVADA. With Special Reference to the Effects of Possible New Withdrawals of Ground Water. Winograd, I. J. (Geological Survey, Denver, Colo. (USA)). Sep 1963. 96p. Dep. NTIS $8.00.

Three general areas in the vicinity of Mercury, Nevada, are being considered by the Atomic Energy Commission for development of a town to facilitate operations at the Nevada Test Site. The hydrologic environment in which the townsite water supplies might be developed and the effects of pumping at each of several potential townsites upon other water supplies were studied. Data are presented on the water requirements, the general geographic and geologic setting, and the general hydrologic setting as the basis for the discussion of groundwater conditions in the vicinity of the various potential townsite areas followed by estimates of aquifer characteristics, which in turn provide the basis for the estimates of effects on other water-supply developments and natural discharge. (CH)

Thermal Effluents

25794 (COM-74-11085) WINTER CONDITIONS IN LAKE ERIE WITH REFERENCE TO ICE AND THERMAL STRUCTURE AND COMPARISON TO LAKES WINNEBAGO (WISCONSIN) AND MILLE LACS (MINNESOTA). Stewart, K. M. (State Univ. of New York, Buffalo (USA). Dept. of Biology). 1973. Contract N0AA-2-35281. 14p. (N0AA-74042601). NTIS $4.00.

A flotation-equipped helicopter was used to obtain data on ice thickness, extent of ice coverage and thermal conditions at 50 to 83 stations in Lake Erie from February to April 1972. Without considering pressure ridges and areas of ice rafting, the average (1972) maximum ice thickness in the western, center, and eastern basins was about 25, 18, and 26 cm, respectively. In contrast to findings from smaller ice-covered lakes, Lake Erie has little to no vertical stratification during winter. In addition, the water temperatures are unusually cold. The 1972 winter transects on Lake Erie suggests no obvious problems of waste heat disposal. (auth)

25795 (COO-2374-1) BUOYANT JETS IN CONFINED SURROUNDINGS. Jirka, G. H.; Harleman, D. R. F. (Massachusetts Inst. of Tech., Cambridge (USA). Ralph M. Parsons Lab. for Water Resources and Hydrodynamics). 1974. Contract AT(11-1)-2374. 19p. (CONF-740584-1). Dep. NTIS $4.00.

From thermal pollution analysis conference; Blacksburg, Virginia, USA (13 May 1974).

Temperature prediction models involve the determination of the spatial and temporal distribution of the discharge into a water body of waste heat from electric power generation. This distribution is governed by different heat transport mechanisms which are a function of the discharge characteristics and of the hydrologic conditions prevailing in the disposal area. Jet analysis by means of the ordinary differential equations, obtained through integration of the governing equations normal to the jet trajectory, is an efficient and accurate technique for the evaluation of thermal discharges. However, in certain instances some of the underlying assumptions, such as small spreading and negligible pressure gradients, may be violated and hence the applicability of the analysis restricted. In the heated surface jet, buoyancy exerts a distorting influence on jet behavior, promoting lateral spreading. It is shown that available techniques are only capable to predict the transition from non-buoyant to more buoyant behavior. The limiting case of buoyancy dominated flow cannot be predicted reliably. Submerged buoyant jets in water of finite depth may exhibit vertical instabilities following impingement upon the free surface. In case of instability, recirculation of already mixed water into the jet zone will occur. Criteria which determine the stable and unstable range as a function of governing parameters are presented. Thermal multiport diffusers are usually characterized by an unstable, recirculating near-field and hence simple buoyant jet analyses are not valid. (auth)

25796 (EPA-660/3-75-002) EFFECT OF METEOROLOGICAL VARIABLES ON TEMPERATURE CHANGES IN FLOWING STREAMS. Troxler, R. W. Jr.; Thackston, E. L. (National Environmental Research Center, Corvallis, Oreg. (USA)). Jan 1975. 85p.

A mathematical model for predicting the change in water temperature in a flowing stream as a function of stream geometry and standard weather information was developed and tested. Five field tests were conducted on cold water released from hydropower stations as it warmed up moving downstream over periods up to 38 hours. Predictions of temperature changes were made based on weather data from a boat floating with the water, data from a station on the bank, and data from a remote weather station 100 miles away. Agreement between predicted and observed temperature changes was good, even with remote data, when adjustments to compensate for the local micro-climate were made. Computer programs and all data are included. (auth)

25797 (IVH/HUU-22/1-74) MEASURES TO REDUCE NEGATIVE RESULTS OF USE OF COOLING WATER. Haugen, I. (Norsk Institutt for Vannforskning, Oslo). 22 Jan 1974. 5p. (In Norwegian). Dep. NTIS (US Sales Only) $4.00.

It is generally accepted that use of a large amount of cooling water by a nuclear power plant will be detrimental to aquatic ecosystems. A number of suggestions for minimizing such negative effects, or for exploiting positive effects, are given. These include using a deep intake in the summer months and an intake near the surface in the winter, and the intake of water containing nutrients, which is then discharged in an area with a good supply of oxygen. The possibility of improving water circulation in badly polluted fjords is also suggested. (NO)

25798 (NYO-3685-17) RISE AND FALL OF DUST IN HOT CHIMNEY PLUMES. Biennial Report, 1969. Csanady, G. T.; Slawson, P. R. (Waterloo Univ., Ontario (Canada). Environmental Fluid Mechanics Lab.). May 1970. 95p. Dep. NTIS $7.75.

Observations on the effects of buoyant gaseous plume rise and behavior on the fallout and dispersion of heavy particles are reported. The studies were made using an oil fog released from a 20-ft pilot stack facility, a 60-ft meteorological tower, and sticky tape samplers on the ground within a 200-ft radius of the stack. Measurements were made of the exit velocity and temperature of each plume. Glass microspheres of varying sizes were injected into the exhaust gases of the chimney at a controlled rate to simulate dust particles. Both cold plume and hot plume experiments were carried out under various meteorological conditions and the plume trajectory and dispersion was recorded on photographs taken at intervals of one minute. The experimental design is described and the aerosol generator and dust injector and measuring instruments used are described. (CH)

25799 THERMAL POLLUTION LOAD CAPACITY OF RHINE RIVER AS A FUNCTION OF WATER POLLUTION. Hoffman, F. O. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F.R. Germany)). Umsch. Wiss. Tech.; 74: No. 21, 667-668(Nov 1974). (In German).

1 fig.; 4 refs.

The growing number of thermal power plants seeking the Rhine River as a source of cooling water has made it necessary to determine the thermal capacity for the river. In 1971 the "Waermelastplan Rhein," which attempted to establish this thermal capacity, was published. Its originally recommended thermal limits had to be lowered, however, because the water quality of the Rhine was far worse than at first assumed. Now, all of the large thermal power plants to be sited on the Rhine will be required to have cooling towers. (auth)

Chemical Effluents

Refer also to abstract 26201.

25800 (SAN-787) DELIQUESCENCE, SIZE DISTRIBUTION, AND CHEMICAL STUDIES OF PURE SALT AND MARINE AEROSOLS. Final Report. Green, W. D. (Meteorology Research, Inc., Altadena, Calif. (USA)). Dec 1974. Contract AT(04-3)-787. 102p. Dep. NTIS $8.25.

Various studies have demonstrated that the lower portion of the marine aerosol size distribution is enriched in organic components derived from surface slicks. Since iodine is concentrated in these organics by absorption or chemical combination, the location and tracing of iodine in the marine environment should be closely coupled to the presence of organic aerosol. The object of this project was to develop a method of detecting a decrease in the deliquescence of small marine aerosols as a function of salt displacement by organics. This method is applicable if the principal contaminant is organic material. Humidity response "signatures" were determined for pure salts, simulated sea water, and urban aerosols. A method was tested for presorting aerosols prior to humidification. A coastal sampling site with over 150 ft of elevation was selected. Preliminary studies of marine aerosol variability as a function of height above the surfline were initiated; however, the scope of the project did not permit direct measurement of marine aerosol deliquescence. (auth)

INSTRUMENTATION

Refer also to abstract 25275.

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 25234, 26229, 27250, and 28803.

25801 (CONF-730941-, pp 62-72) CHARACTERISTICS OF MULTIWIRE PROPORTIONAL CHAMBERS FOR POSITRON IMAGING. Perez-Mendez, V. (Univ. of California, San Francisco). 1973.

From grantees conference on instrumentation technology; Washington, District of Columbia, USA (25 Sep 1973).

In proceedings of the grantees conference on instrumentation technology.

The developmental work on a positron camera using multiwire proportional chambers with lead converters as the position-sensitive gamma detectors is described. (WHK)

25802 (KHFTI-74-4) FAST LOGIC SCHEMES FOR MULTICHANNEL COUNTERS OF CHARGED PARTICLES. Denyak, V. M.; Nemashkalo, A. A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The units of the fast logic, developed for multichannel counters of charged particles are described. Schemes are given on the integral elements with fast response of 50 mc. The principal characteristics of the scheme, and three varieties of the scheme are given for different types of multichannel counters are given. (auth)

25803 (LUIP-CR-74-07) EXPERIMENTAL AND THEORETICAL ABSORPTANCE PROFILES OF TRACKS OF FAST HEAVY IONS IN NUCLEAR EMULSION. Jensen, M.; Larsson, L.; Mathiesen, O.; Rosander, R. (Lund Univ. (Sweden). Fysiska Institutionen). Aug 1974. 49p. Dep. NTIS (US Sales Only) $5.50.

Transverse absorptance profiles of 27 tracks of cosmic ray nuclei recorded in Ilford G5 nuclear emulsion have been measured by a nuclear track photometer. Included in the study were nuclei with atomic numbers 14, 16, 20, 24 and 26 with velocities relative to that of light within the interval $0.3 \leq \beta \leq 0.8$. The experimental absorptance profiles have been compared with theoretical profiles calculated from the δ-ray theory of track formation developed by Katz and coworkers. Taking into account the re-scattering of light into the cone of acceptance of the photometer, good agreement has been found between experimental and theoretical profiles within the entire charge and velocity interval. The semi-empirical formula for high aperture photometry is discussed in some detail, as well as the theory of δ-ray production and the transport of electrons and their energy dissipation in nuclear emulsion. (auth)

25804 (LUIP-CR-74-10) TRACK FORMATION THEORY BY KATZ AND COWORKERS APPLIED TO IONIZATION MEASUREMENTS IN NUCLEAR EMULSION. Jensen, M.; Mathiesen, O. (Lund Univ. (Sweden). Fysiska Institutionen). Oct 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

The track formation theory by Katz and coworkers is based on the concept of the energy dose deposited by secondary electrons at different radial distances from the path of a passing ion. The theory was originally developed for calculation of the track structure of heavy ions in nuclear emulsion. While the application of the theory in recent years has been extended to new areas of research, such as biology and medicine, the nuclear emulsion still seems to be best suited for a somewhat more detailed test of the basic elements of the theory. In this paper the results are given of such a test, based on a comparison of the theoretical and experimental data of the transmittance (or absorptance) of light in an emulsion volume containing the track. (auth)

25805 (N-74-29345) RESEARCH ON RADIATION DETECTORS, BOILING TRANSIENTS, AND ORGANIC LUBRICANTS. Final Report. (Cincinnati Univ., Ohio (USA)). 19 Jul 1974. 44p. (NASA-CR-138882). NTIS $5.25.

The accomplishments of a space projects research facility are presented. The subjects discussed are: (1) a study of radiation resistant semiconductor devices, (2) synthesis of high temperature organic lubricants, (3) departure from phase equilibrium during boiling transients, (4) effects of neutron irradiation on defect state in tungsten, and (5) determination of photon response function of NE-213 liquid scintillation detectors. (auth)

25806 (NP-20346) EFFECT OF DEAD-TIME ON THE STOCHASTICS IN PULSE DETECTION SYSTEMS. de Vries, J. W. (Interuniversitair Reactor Instituut, Delft (Netherlands)). May 1974. 52p. (In Dutch). Dep. NTIS (US Sales Only) $5.75.

In practice, the dynamics of pulse detection systems are not unbound, but confined within certain limits. Especially, the high frequency characteristic is of importance in conjunction with the resolution of the system. As a consequence, an upper boundary is imposed upon the number of events the system is capable of processing per unit time interval. If the observed process is of a stochastic nature, always some information concerning the process will be lost. In the limiting case, there will be no information at all and, therefore, one is faced with complete uncertainty. This phenomenon manifests itself in increasing the expected variance of the observed process. The expected variance of the observed pulse frequency on the contrary is decreased. This could create the impression that the measurement is more accurate than actually is the case. The merits of these phenomena as they appear with the registration of nuclear processes are discussed. However, the method outlined is generally applicable to a wide variety of stochastic processes. (auth)

25807 MEASURING INSTRUMENTS FOR RADIATION PROTECTION: KEY TO NUCLEAR TECHNIQUE. Kosmowski, A. Wasser, Luft Betr.; 18: No. 11, 595-597(Nov 1974). (In German). 8 figs.; 2 refs.

Control in radiation protection is, of necessity, graduating from supervision by trained personnel to self-control by the persons concerned. This applies not only to nuclear power stations and atomic research centers but also to isotope laboratories and to technical, medicinal, and scientific fields of application for radioactivity. New measuring and warning instruments have been developed for this purpose, and a few of them are described. (auth)

25808 USE OF NUCLEAR TRACK DETECTORS IN THE DESIGN OF NEUTRON COLLIMATORS AND SCATTERERS. Hita, K.; Ettinger, K. V.; Khan, H. A. (Univ. of Birmingham, Eng.). Phys. Med. Biol.; 19: No. 6, 879-883(Nov 1974).

Neutron beam contours and uniformity of irradiation are of great importance in installations for the in vivo irradiation of humans. Track detectors, which rely on the production of etchable damage trails by heavy charged particles inside the body of the detector, provide a flexible and inexpensive method of determining these parameters with a relatively high detection efficiency (approximately 10^{-6} tracks per 1 MeV neutron). A technique is described using Daicel cellulose nitrate track detectors for the study of neutron beam profiles in installations used for neutron therapy. (UK)

25809 CALCULATION OF THE SENSITIVITY OF SPHERICAL NEUTRON DETECTORS. Utkin, V. A. Vop. Fiz. Zashch. Reaktorov; No. 6, 182-190(1974). (In Russian).

The theory of adjoint equations was applied to the study of the sensitivity of spherical neutron detectors in which the point detector is in the center of a homogeneous spherical moderator layer. Functionals expressing the integral current registered by the detectors are derived for point monodirectional, point isotropic, plane isotropic, and plane monodirectional detectors. For spherical detectors with polyethylene moderator a comparison was made of the experimental and calculated values of the function of sensitivity to neutrons of a plane monodirectional source. (JSR)

25810 GAMMA-RAY DETECTION IN AN INTENSE FLUX OF 14 MeV NEUTRONS. Steuer, M. F.; Etten, M. P. (Georgia Univ., Athens (USA). Dept. of Physics). Nucl. Instrum. Methods; 122: No. 3, 443-446(15 Dec 1974).

The hexafluorine-based scintillator NE226 is compared to the toluene-based scintillator NE213 as a detector of gamma radiation in the presence of 14 MeV neutrons. It is shown that when pulse shape discrimination techniques are employed NE213 is superior because the NE226 is an efficient detector of 14 MeV neutrons through the ^{19}F(n, particle, gamma) reactions. (auth)

25811 GAMMA-RAY SELF-ABSORPTION CORRECTIONS FOR $E_\gamma > 0.6$ MeV AND $\mu < 3$ cm^{-1}. Horowitz, Y. S.; Mordechai, S.; Dubi, A. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Nucl. Instrum. Methods; 122: No. 3, 399-404(15 Dec 1974).

The Monte Carlo method was used to calculate the self-absorption correction for a large number of cylindrical source-cylindrical detector configurations in the energy range E_γ greater than 0.6 MeV and for values of the total attenuation coefficient (μ) up to 3 cm^{-1}. The corrections are thus applicable to all possible materials and compounds and are presented in a functional form which allows easy calculation and interpolation. The error introduced by using the self-absorption correction multiplied by a non-absorbing

source-detector efficiency is discussed and shown to be usually negligible. The problem of forward-scattered Compton γ-rays from the source contributing to the photopeak efficiency in NaI(Tl) detectors is shown to be increasingly significant for $E_\gamma < 0.6$ MeV. (auth)

25812 A MODEL-BASED EFFICIENCY CALIBRATION OF A Si(Li) DETECTOR IN THE ENERGY REGION FROM 3 TO 140 keV. Gallagher, W. J.; Cipolla, S. J. (Creighton Univ., Omaha, Nebr. (USA)). Nucl. Instrum. Methods; 122: No. 3, 405-414(15 Dec 1974).

The full-energy peak efficiency in a particular geometry of a collimated 3 mm × 30 mm² Si(Li) detector with 0.5 mil thick beryllium and Mylar windows was determined over the energy range 3.3 to 136 keV by measuring the absolute intensities of X- and low-energy γ-rays from the decays of intensity-calibrated sources of ^{241}Am, ^{57}Co, ^{137}Cs, and ^{65}Zn. The measured efficiencies were fitted to a simple analytic function of photon energy, with the fit showing good agreement with the data over the entire range of energies. The physical basis of the model as well as the meaningfulness of its parameters is discussed. A discrepancy between the fit and the measured efficiency of the 17.75 keV $L_\beta + L_\eta$ X-rays from ^{241}Am decay required a re-evaluation of the intensity per decay for these transitions. Some peculiarities of the low-energy efficiency response are discussed and are attributed to source self-absorption effects. The extension of the calibration to lower energies would be possible if more low-energy photon sources with known X-ray intensities were available. The use of L X-rays and L/K intensity ratios calculated from published data for medium-Z elements is discussed and is considered to be feasible for this extension purpose. Some radio-nuclides that are likely to be useful in the low-energy region are suggested. (auth)

25813 TRANSIENT RESPONSE OF SELF-POWERED NEUTRON DETECTORS. Boeck, H. (Atominstitut der Oesterreichischen Hochschulen, Vienna); Gebureck, P.; Stegemann, D. (Technische Univ. Hannover (F. R. Germany)). Nucl. Instrum. Methods; 123: No. 1, 117-123(1 Jan 1975).

The behavior of self-powered neutron detectors with Co, Er, Hf, and Pt emitters was investigated during reactor square wave and pulse operation. The detector's response was compared with the current of an excore ionization chamber. Characteristical deviations from linearity were observed with all detectors at fast reactor periods. The exact cause of these deviations is not yet fully understood but several possibilities for the non-linear behavior of self powered neutron detectors are outlined. (auth)

25814 COUNTING ALPHA PARTICLES FROM THE ^{6}Li + n REACTION BY TRACK-ETCH METHODS. Hahn, P. B.; Wechter, M. A.; Voigt, A. F. (Ames Lab., Iowa (USA)). Nucl. Instrum. Methods; 123: No. 1, 111-116(1 Jan 1975).

The track etch-spark counting technique using thin cellulose nitrate films has been demonstrated to be successful for measuring approximately 2 MeV alpha particles from a ^{210}Po alpha source and from the ^{6}Li(n,α)^{3}H reaction. Precision of measurement was found to approach that of counting statistics and the linearity of response extended to approximately 2000 spark counts/cm² of detector film. The potential application of the technique to a surface activation analysis by the (n,α) reaction was investigated by irradiating ^{6}LiF thermoluminescence detector crystals in a neutron flux using an evacuated irradiation chamber. (auth)

25815 PERFORMANCE OF A SILICON PROTON POLARIMETER BETWEEN 19 AND 32 MeV. Birchall, J.; Conzett, H. E.; Dahme, W.; Arvieux, J.; Rad, F. N.; Roy, R.; Larimer, R. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Instrum. Methods; 123: No. 1, 105-109(1 Jan 1975).

The design is presented of a proton polarimeter which combines the advantages of high scattering efficiency and good energy resolution. The polarimeter, intended for proton energies above 17 MeV, is well-suited to the study of polarizations in low-yield reactions and has been used in the measurement of triple-scattering parameters. A typical figure of merit $A\sigma^2$ of $\sim 2.2 \times 10^{-3}$ and an energy resolution of approximately 100 keV fwhm at 26 MeV make the present type of polarimeter superior to others for experiments where good energy resolution is required. (auth)

25816 REDUCTION OF THE IONIZATION LOSS DISTRIBUTION WIDTH OF SEVERAL SIMULTANEOUS RELATIVISTIC PARTICLES TRAVERSING A SCINTILLATION COUNTER. Aderholz, M.; Lehraus, I.; Matthewson, R. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 123: No. 1, 45-50(1 Jan 1975).

A Poisson distribution of a number of electrons at the input stages of a photomultiplier has been folded into the Landau-Symon distribution of ionization losses in a plastic scintillator and a distribution of the smallest value out of n detectors was derived analytically for m simultaneous particles. A group of four identical scintillation counters was constructed and the smallest of the four output pulses was used for selective triggering of the bubble chamber flash with the greater precision engendered by the considerably reduced distribution width. (auth)

25817 MULTIELEMENT DETECTOR DATA ANALYSIS. Arens, J. F.; Fisher, A. J.; Ormes, J. F. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Nucl. Instrum. Methods; 123: No. 1, 61-65(1 Jan 1975).

A geometric method of analyzing multidetector data by using a multidimensional space is presented. The χ^2 is minimized for each event and the resulting χ^2 curve provides the selection criterion for separating good events from background. (auth)

25818 TWO SIMPLE CIRCUITS FOR IN-BEAM μs AND ms TIME MEASUREMENTS. Filevich, A.; Lagos, M. (Chile Univ., Santiago. Facultad de Ciencias). Nucl. Instrum. Methods; 122: No. 3, 605-609(15 Dec 1974).

Two simple circuits for in-beam μs and ms time measurements, using the pulsed beam of a cyclotron, have been developed. A detailed description of the systems and the calibration procedures are presented. The decay of the 8^+ isomeric state in ^{88}Y was measured using the first system. The second system has been tested using long-lived radioactive sources. (auth)

25819 A MULTIWIRE PROPORTIONAL CHAMBER AS A POLARIMETER FOR FAST NEUTRONS. Sikkema, C. P. (Rijksuniversiteit Groningen (Netherlands)). Nucl. Instrum. Methods; 122: No. 3, 415-431(15 Dec 1974).

The azimuthal asymmetry of the scattering of polarized neutrons by helium nuclei is measured by detecting the recoil alpha particles in a multiwire proportional chamber. The required information on the direction of the particles is obtained from the particle energy, from the spread in the drift time of the collected electrons and from the difference in discharge position on successive collecting wires. This difference is determined in a direct way by means of a newly developed electronic system. Since with the present method no diaphragms are used for the direction determination of the recoil particles, the associated geometrical asymmetries and limitations of the sensitive volume are avoided. The scattering asymmetry is determined simultaneously for a range of scattering angles. Results obtained with polarized d-d neutrons are presented. They show good agreement with known n-α scattering phase shifts and polarization values obtained recently by other techniques. (auth)

25820 COMPARATIVE STUDIES ON PLASTIC SCINTILLATORS-APPLICATIONS TO LOW ENERGY HIGH RATE PHOTON DETECTION. Eriksson, L. A.; Tsai, C. M.; Cho, Z. H. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology); Hurlbut, C. R. (Nuclear Enterprises, San Carlos, California, USA). Nucl. Instrum. Methods; 122: No. 3, 373-376(15 Dec 1974).

The possible uses of plastic crystals in high rate single counting experiments have been investigated. Two different plastic crystals were studied: a conventional plastic crystal (NE 111) and a tin-loaded plastic crystal (5% Sn, NE140). It was found that the tin-loaded plastic crystal had the same total absorption efficiency as a NaI(Tl) crystal of the same size for gamma energies below 60 keV. Both crystals have a decay time of a few nanoseconds. At 120 keV the total absorption efficiency relative to NaI(Tl) was about 40%. The high detection efficiency, in addition to the excellent time properties imply that the tin-loaded plastic crystals are well suited for low energy high count rate experiments such as tomographic X- and gamma-ray scanning. (auth)

25821 REFINED MODEL OF LUMINESCENCE PRODUCTION IN PLASTIC SCINTILLATORS. Muga, L.; Diksic, M. (Florida Univ., Gainesville (USA). Dept. of Chemistry). Nucl. Instrum. Methods; 122: No. 3, 553-558(15 Dec 1974).

Refinement is made of a previously reported model describing the specific luminescence of plastic scintillators when penetrated by energetic heavy ions. A detailed description of the model is given and simplifying assumptions on which it is based are discussed. Appropriate relations are derived which describe the scattered electron density profile along the path of the moving heavy-ion. Comparison of results with those of the original model is shown. The concept of saturation of luminescence centers leads to an explicit relation from which relative specific luminescence data may be calculated. An additional empirical correction provides calculated specific luminescence values that are in remarkably good agreement with experimental data. Figures of calculated and experimental values of specific luminescence are shown for ^{16}O, ^{35}Cl, ^{40}Ar, ^{79}Br, and ^{127}I ions over an energy range from less than 10 MeV to about 140 MeV. (auth)

25822 SEMI-EMPIRICAL EFFICIENCY EQUATIONS FOR Ge(Li) DETECTORS. Hajnal, F.; Klusek, C. (USAEC Health and

Safety Lab., New York). Nucl. Instrum. Methods; 122: No. 3, 559-565(15 Dec 1974).

A semi-empirical efficiency equation is derived for Ge(Li) detectors in the 12 keV to 11 MeV energy range. The efficiency is given in the terms of the mass attenuation coefficients of Al and Ge, the window thickness, the cross sections and the average scattered gamma-ray energies. The constants of the equations are determined from measured full energy peak efficiency values. The semi-empirical formula agrees with the measured full-energy peak efficiencies to within 2%. (auth)

25823 TRACK-ETCH IMAGING EFFICIENCIES OF THE $^{10}B(n,\alpha)^{7}Li$ AND $^{6}Li(n,\alpha)T$ REACTIONS. Harms, A. A.; Moniz, M. S. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Engineering Physics). Nucl. Instrum. Methods; 122: No. 3, 567-573(15 Dec 1974).

The relative effectiveness of two important neutron-induced reactions employed in track-etch imaging are analyzed. The basis for the evaluation is the formulation of a physically plausible model of radiation conversion and nuclear track formation. It is found that distinct conversion efficiency extrema and asymptotes exist. Although both reactions are characterized by similar efficiency maxima, the ^{10}B reaction possesses the potential to permit extremely high spatial resolution radiography. Optimum converter thicknesses exist for both reactions for a central converter imaging system. (auth)

25824 SOLID ANGLE FOR ELECTRON DETECTION IN A HOMOGENEOUS MAGNETIC FIELD. Andersen, V. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nucl. Instrum. Methods; 122: No. 3, 543-545(15 Dec 1974).

The electron collection efficiency was calculated of a system built up with a solid-state detector in a homogeneous magnetic field. Calculations were made both for a point-source and for sources not negligible in size compared to the detector. A simple connection between efficiency and system parameters was found for a point-source. (auth)

25825 THE INVESTIGATION OF CONTROLLABLE SECONDARY ELECTRON EMISSION FROM SINGLE PARTICLES. Lorikian, M. P.; Kavalov, R. L.; Trofimtchook, N. N. (AN Armyanskoj SSR, Erevan. Inst. Fiziki). Nucl. Instrum. Methods; 122: No. 3, 377-382(15 Dec 1974).

This paper deals with the controllable secondary electron emission from a low-density dielectric layer at the passage of single 0.7 to 2 MeV electrons. The absence of space charge in the dielectric is shown to cause in this case the fundamental difference between the secondary emission observed and the anomalous secondary emission. The secondary emission coefficient as well as the particle detection efficiency exceed by far those for anomalous secondary electron emission. (auth)

25826 MAGNETIC FIELD DEPENDENCE OF THE ENERGY RESOLUTION OF SILICON SURFACE-BARRIER DETECTORS. Byrne, J.; Shaikh, F.; McComb, T. J. L. (Sussex Univ., Brighton (UK). School of Mathematical and Physical Sciences). Nucl. Instrum. Methods; 122: No. 3, 347-350(15 Dec 1974).

A study of the resolution of large silicon surface-barrier detectors, operated in axial magnetic fields up to 4.0 T, has shown that a small (~0.5%) reduction in resolution occurs which may be interpreted as arising from a slight decrease in the depth of the depletion layer. (auth)

25827 A PULSED SPARK-DISCHARGE COUNTER MODULE. Madey, R.; Yushak, S. M. (Kent State Univ., Ohio (USA). Dept. of Physics). Nucl. Instrum. Methods; 122: No. 3, 491-498(15 Dec 1974).

Sealed-double-gap spark-discharge modules for detecting ionizing radiation have been designed and constructed with active diameters 1.75 and 3.0 in. The module consists essentially of three parallel electrodes separated by two ceramic annular spacers. It is filled with a noble gas mixture of 90% neon and 10% helium. Some useful properties of the spark-discharge counter module are that it is a triggered device with an output pulse of large amplitude; the detection efficiency for minimum-ionizing particles is about 99%; the sensitive time is typically of the order of 2 μs with a suitable steady clearing field; and it can be produced with larger active diameters and sealed against rugged external environments. (auth)

25828 FISSION FRAGMENT SPECTROSCOPY BY MEASUREMENTS IN NUCLEAR TRACK DETECTORS APPLIED TO THE FISSION OF SILVER INDUCED BY 80 MeV ALPHA PARTICLES. Blok, H.; Pate, B. D. (Simon Fraser Univ., Burnaby, British Columbia (Canada). Dept. of Chemistry); Peter, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Nucl. Instrum. Methods; 122: No. 3, 329-341(15 Dec 1974).

A method is presented for the analysis of track length distributions in mica track detectors and track diameter distributions in glass detectors, produced by the fission fragments of medium mass nuclei. Measured distributions are compared with distributions calculated from trial values for the total kinetic energy release, the center-of-mass motion, and the form of the fragment mass distributions. A FORTRAN computer program has been written that calculates the relevant quantities for the fission process under study and incorporates the characteristics of the stopping process of the fragments. The resulting calculated track length and track diameter distributions show only a moderate sensitivity towards the shape of the fragment mass distribution. A simple fitting procedure is shown to give good estimates of the total kinetic energy release as well as of the center-of-mass motions for medium mass fissioning systems. The method is applied to data from the 80 MeV alpha-particle-induced fission of silver, and yields a value for the total kinetic energy release of this system which is higher than present theoretical estimates. (auth)

25829 ANGULAR RESOLUTION OF PARTICLE EXPERIMENTS ON BOARD SPACECRAFTS WITHOUT MAGNETIC STABILIZATION. Auschrat, V. W.; Fischer, H. M. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik). Nucl. Instrum. Methods; 122: No. 3, 499-510(15 Dec 1974).

For a particle telescope looking into an anisotropic pitch-angle distribution the gathering power depends on the particle distribution function $F(\theta)$ and on the angular aspect of the experiment $\psi(t)$ with regard to a preferential direction. The response function of three cylindrically symmetric detector configurations on different angular particle distributions and, as a consequence, the enlargement of the path lengths of particles passing through the detector combined with accordingly higher energy loss is discussed. Finally the mechanical shielding around the detectors is investigated according to its effectiveness. Highly energetic particles penetrating through the shielding into the sensitive detector volume cause a background counting rate which is modulated with the aspect angle $\psi(t)$. (auth)

25830 TEST OF A LIQUID ARGON CHAMBER WITH 20 μm rms RESOLUTION. Derenzo, S. E.; Kirschbaum, A. R.; Eberhard, P. H.; Ross, R. R.; Solmitz, F. T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Instrum. Methods; 122: No. 3, 319-327(15 Dec 1974).

A measurement of the spatial resolution of a liquid-argon filled chamber was performed with minimum ionizing particles. Two multistrip chambers with 20 μm strip spacing operating in the ionization mode were used in the experiment. They perform in accordance with a simple model based on electron diffusion. An estimate of the amount of electron diffusion in liquid argon is given and the time jitter distribution has a fwhm of 200 ns. Under best conditions, the spatial resolution is better than 20 μm rms with an efficiency of nearly 100%. (auth)

25831 THE SPHERICAL DRIFT CHAMBER FOR X-RAY IMAGING APPLICATIONS. Charpak, G.; Hajduk, Z.; Jeavons, A.; Stubbs, R. (European Organization for Nuclear Research, Geneva (Switzerland)); Khan, R. (LURE, Centre Universitaire, Orsay, 91405, France). Nucl. Instrum. Methods; 122: No. 3, 307-312 (15 Dec 1974).

Properties of proportional chambers with spherical drift spaces have been investigated. An experiment of X-ray diffraction in crystals shows that an accuracy of 0.5 mm, at 20° inclination with respect to the axis of the chamber, can be obtained with 4 cm of drift length. Such chambers have many applications: X-ray diffraction patterns, pin-hole imaging, angular distributions of cascades of X-rays in nuclear physics, etc. (auth)

25832 NEW TECHNOLOGY FOR FABRICATING SEMICONDUCTOR DETECTORS. Solov'ev, S. M. pp 105-107 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

A device for protecting the Ni contact of Si surface-barrier detectors during etching of the work surface of the detector is described in detail. The device is made of teflon and silicon resins. (JSR)

25833 PRECISION α PARTICLE COUNTER BASED ON LARGE AREA SEMICONDUCTOR DETECTOR. Geidel'man, A. M.; Devyatko, N. N.; Smirnov, A. N.; Solov'ev, S. M.; Eismont, V. P. pp 108-110 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The counting of α particles in a specified solid angle is one of the absolute methods of measuring the activity of α sources. The use of semiconductor detectors for counting the α particles makes it possible to simplify the electronic circuit of such a counter and simultaneously to carry out an isotopic analysis of the source. The design for this type of counter is given. The results of tests on the performance of a semiconductor α counter using ^{241}Am as the source are reported and show that

the error in the determination of the activity of α sources does not exceed 0.2. (JSR)

25834 APPARATUS FOR STUDYING SHORT-LIVED ISOMERIC STATES OF ATOMIC NUCLEI. Gutii, A. I.; Kovach, P. Sh.; Shkoda-Ul'yanov, V. A.; Yakovlev, B. M. pp 162-165 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

An experimental installation for measuring the lifetimes of milli- and microsecond isomeric states induced by photonuclear reactions is described. The installation operates in the interval between pulses of a 25-MeV betatron. The γ spectra of a Br sample irradiated with bremsstrahlung at 18 MeV are given as an example of the results obtained with the installation. The structural circuit used for measurement of the yield curves of isomeric states with half lives greater than 100 μsec is given. (JSR)

25835 USE OF 14.1-MeV NEUTRONS FOR DETERMINATION OF THE CHARACTERISTICS OF Si SEMICONDUCTOR DETECTORS. Klochkova, L. I.; Kuritsyn, V. N.; Kovrigin, B. S. pp 166-170 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

Two methods are described for the use of 14.1-MeV neutrons in the determination of the thickness of the sensitive region of Si detectors. The first method is based on the counting of protons of a specified energy by the semiconductor detector being studied and a construction of the dependence between the pulse amplitude of the detector and the proton energy. The protons were obtained as a result of the elastic scattering of 14.1-MeV neutrons on the hydrogen atoms of thin polyethylene targets. The second method is based on the measurement of the energy spectra of the products from the nuclear reactions $^{28}Si(n,p)^{28}Al$ and $^{28}Si(n,\alpha)^{25}Mg$, arising in the detector being studied from neutron reactions. Both methods give satisfactory results on the thickness of the sensitive region. (JSR)

25836 LINEAR INTEGRATION CIRCUIT FOR SEMICONDUCTOR Ge(Li) DETECTORS. Aloev, A. S.; Vartanov, N. A.; Kazadov, Yu. E.; Stugarev, Yu. N. pp 217-221 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

A transistorized linear integration installation was constructed for use with two semiconductor Ge(Li) detectors. The principal electrical circuits of linear integration are given. The structural circuit for inclusion of the linear integration installation is shown and described. The efficiency of the installation was verified by measurement of the γ spectrum of ^{22}Na. The basic characteristic of the integration circuit was its linearity in the entire range of integrated pulse amplitudes. (JSR)

25837 HIGHLY EFFECTIVE METHOD FOR THE DETERMINATION OF γ EMITTING NUCLIDE CONCENTRATION IN THE HUMAN ORGANISM. Fedorov, G. A.; Moiseev, I. F.; Konstantinov, I. E. pp 241-252 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The different variations of measurement in the use of stationary geometry for the placement of detectors in human spectrometry are analyzed. The measurement method consists of the placement of a series of detectors close to the surface of the object measured, variation of the efficiency or counting time of each detector, and determination of the geometric mean of two measurements by detectors placed over and under the body measured. The mathematical bases of the method are outlined and calculation algorithms are given. The calculation results are reported in a series of graphs. They show the maximum counting inhomogeneity for point sources, the absolute counting efficiencies, the minimum detectable activity, and the effect of statistical fluctuation in the number of measured pulses. (JSR)

25838 IMPROVEMENTS IN LIQUID COMPOSITIONS FOR SCINTILLATION COUNTINGS. (to Packard Instrument Co., La Grange, Ill. (USA)). French Patent 2179917/A/. 10 Apr 1973. Priority date 10 Apr 1972, United Kingdom of Great Britain and Northern Ireland. 22p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A composition for the counting of aqueous radioactive samples is described. A small proportion of an ethoxyl substitute carboxylic acid and a tertiary amine or quaternary ammonium salt of the acid is added to a system consisting of an aromatic hydrocarbon (solvent), an ethoxyl alcoylphenol (surface-active agent), and a scintillation agent. A decrease of the chemoluminescence is obtained during the addition of an alkaline sample and an improvement of the degree of miscibility of the system with water is achieved so that a single and unique phase of low viscosity is obtained in a wide interval of composition and temperature. (tr-FR)

25839 INVESTIGATION OF THE ZONAL CHARACTERISTICS OF CHANNEL ELECTRON MULTIPLIERS WITH A FUNNEL. Ainbund, M. R.; Pronin, V. P.; Stozharov, V. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1129-1131(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 156-158(1974).

The zonal characteristics of Soviet channel electron multipliers (c.e.m.) with a funnel were investigated. It was shown that when the electron beam is incident at the center of the c.e.m. funnel, the efficiency may increase notwithstanding the reduction of the gain. The increase in efficiency can be explained by the change in the angle of incidence of the electron beam on the surface of the input funnel of the c.e.m. (auth)

25840 CHARACTERISTICS OF CHANNEL ELECTRON MULTIPLIERS WITH A FUNNEL AT THE INPUT. Ainbund, M. R.; Kovalenko, V. G.; Polenov, B. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1126-1128(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 154-156(1974).

The construction and characteristics of channel electron multipliers with a funnel at the input end are described. The characteristics were investigated while recording electrons having energies of 0.4 to 4 kV. (auth)

25841 APPARATUS FOR MONITORING RADIOACTIVITY IN A GAS. Gant, P. L.; Motes, B. G.; Brundage, R. S. (to Continental Oil Co.). Canadian Patent 959,580. 17 Dec 1974. vp.

A method is described for measuring radioactivity of plural, different gases in a natural gas sample which may include electronegative gas products. The method utilizes a radioactivity detection chamber having plural detection outputs, which is used in combination with circuitry, which analyzes the outputs from the chamber as to energy and quantity to measure the radioactivity of two or more isotopes in the mixed gas sample. In a more limited aspect, the invention comprises a combination of elements which includes a detection chamber having associated therewith a plurality of ionization detection circuits coupled in predetermined manner as between first and second detection outputs. The first and second detection outputs are then applied to respective signal processing channels, each of which includes pulse height analyzing means in series with single channel analyzing means to derive low or high emission energy outputs from the pulse height analyzing means. Thereafter, low energy outputs from each channel are further examined for coincidence to verify as to the probability of the energy of the event pulse. (auth)

25842 DETERMINATION OF FULL ENERGY PEAK EFFICIENCIES OF A COAXIAL Ge (Li) DETECTOR. Ozmutlu, C.; Ozyol, H.; Ortaovali, A. Z. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 2: No. 1, 19-23(Feb 1975).

The full energy peak efficiency of a coaxial Ge(Li) detector which has 60 cm^3 active volume was measured. The dimensions of the detector are 49.5 mm. height; 43.23 mm. outer diameter and 9.25 mm. core diameter. Graphs are presented which show how the efficiency varies for gamma ray energies 59.55 keV to 1332.49 keV and for the detector source distance in the range 1.515 cm. to 7.150 cm. (auth)

25843 RECORDING LOSSES IN DETECTOR SYSTEMS WITH LENGTHENING DEAD TIME. Markovski, B. L.; Spasov, V. L. (Inst. of Nuclear Research and Nuclear Energy, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 12, 1639-1642(1974). (In Russian).

Formulas are derived to express the recording losses in detector systems with a prolonged dead time. (JSR)

25844 APPARATUS FOR MEASURING IODINE. Wilhelm, J.; Gerlach, K.; Mahnau, H. (to Gesellschaft fuer Kermforschung mbH and Herfurth GmbH). US Patent 3,864,574. 4 Feb 1975. Filed Date 14 Mar 1973. 6p.

In an apparatus for measuring a radioactive iodine isotope in air, there is provided a conduit that carries the iodine-containing air, a scintillation crystal disposed in the conduit in an axially coextensive manner and an iodine-adsorbing filter which surrounds the scintillation crystal at least along a length portion thereof and entirely fills the cross-sectional area of the conduit at any point along that length portion. The apparatus responds with substantially the same efficiency to both elemental and chemically bound iodine. (Official Gazette)

25845 LOW ENERGY X-RAY DETECTOR. Zingaro, W. P. US Patent 3,864,570. 4 Feb 1975. Filed Date 24 Sep 1973. 4p.

A detector for low energy x-rays which employs a lithium doped silicon crystal and an FET preamplifier cooled cryogenically is described. In order to avoid contamination of the crystal and FET by oil vapors and other condensates produced during evacuation of an instrument for producing soft x-rays, the detector is provided with two ultra-thin windows spaced apart and defining a space which connects with the instrument. Thus, while the instrument is evacuated air is also withdrawn from the space between the

windows, and when air is introduced, the air flows through a filter prior to entering that space. The air is thus filtered to remove contaminants. The windows consist of thin films of a synthetic resin which transmit low energy x-rays substantially without attentuation but because they are so thin, they are unable to withstand any substantial pressure. (Official Gazette)

Radiation Dosimeters

Refer also to abstract 27774.

25846 (AAEC/E-332) STANDARDIZATION OF ABSORBED DOSE BY MEANS OF AN ALUMINIUM CALORIMETER. Urquhart, D. F.; Badger, W. S.; Johnson, E. P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

An aluminium calorimeter was used to determine an absorbed "dose in water" calibration factor for a thimble ionization chamber for ^{60}Co gamma radiation. Several distinct steps were involved in the calibration. An absorbed "dose in aluminium" calibration factor for the chamber was measured to determine the effect of depth on this factor; this calibration factor was used to transfer experimentally the measured dose in aluminium to dose in a water phantom at depths of 5 cm and 7 cm for a range of field sizes. A build-up factor (to describe the radiation quality) in the water phantom was calculated as a function of depth and field size. Using these steps, an absorbed dose in water calibration factor for the thimble chamber was measured over a limited range of radiation quality. Two further experiments were made to test the overall calibration procedure. The dose in water measurements were used to determine the G-value for ferric ion production by irradiating ferrous sulfate dosimeters for two or three field sizes at depths of 5 and 7 cm, respectively. The measured G-values were compared with those obtained by other workers using calorimetry. The long-term stability of the calorimeter was observed over a period of about 14 months, during which time no change was detected in the calorimeter. (auth)

25847 (AED-CONF-74-509-003) UNCERTAINTY ANALYSIS FOR DOSIMETRY IN A MIXED FIELD OF NEUTRONS AND PHOTONS. Goodman, L. J. (Columbia Univ., New York (USA). Radiological Research Lab.). 1974. 8p. INIS.

From second symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

3 refs. With abstract. Available from ZAED.

In most mixed fields of neutrons and photons two dosimeters with different sensitivities to the two types of radiation are commonly used to evaluate the separate absorbed doses. One instrument is constructed so as to have a low sensitivity to an absorbed dose of neutrons relative to its sensitivity to an equal absorbed dose of photons. Uncertainty in this neutron sensitivity, k(U), produces uncertainties in the computed values of the two components of absorbed dose. A general quantitative analysis and a graphical display of these uncertainties are presented. Practical examples are used to demonstrate that uncertainty in k(U) usually does not contribute significantly to the uncertainty of the absorbed dose of neutrons. However, it is shown that it is difficult to accurately determine the absorbed dose of photons when this component is small relative to the absorbed dose of neutrons. Recommendations are made for minimizing these uncertainties. (auth)

25848 (AED-CONF-74-509-004) AN INTERNATIONAL NEUTRON DOSIMETRY INTERCOMPARISON. Goodman, L. J.; Colvett, R. D.; Caswell, R. S. (Columbia Univ., New York (USA). Radiological Research Lab.). 1974. 26p. INIS.

From second symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

18 figs.; 1 tab.; 14 refs. With abstract.

An International Neutron Dosimetry Intercomparison, sponsored by the ICRU, has been completed at the Radiological Research Accelerator Facility at BNL. Fourteen groups of scientists, from six countries, performed measurements to determine the separate neutron and photon (X- and gamma-ray) tissue kermas in free air for four energies of monoenergetic neutrons, 15.5, 5.5, 2.1, and 0.67 MeV, and for a source of fission neutrons, ^{252}Cf. For the two highest energies, measurements were also made to determine the separate absorbed doses in tissue of neutrons and of photons at three depths in a large water phantom. (auth)

25849 (AED-CONF-74-509-005) A CALORIMETER FOR NEUTRON DOSIMETRY. Greene, D.; Major, D.; Redpath, T. (Christie Hospital and Holt Radium Inst., Manchester (UK)). 1974. 13p. INIS.

From second symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

4 figs.; 9 refs. With abstract.

The use of a polythene calorimeter for neutron dosimetry is described. The temperature measuring system was based on the use of thermistors, and the calorimeter was calibrated with ^{60}Co- γ-rays. The dosimetric measurements made in the field of a 14 MeV neutron generator are compared with determinations based on the use of a polythene-ethylene ionization chamber, and excellent agreement was found. The result may be interpreted as a determination of the ratio Wn/We for ethylene, the value obtained being 1.07 ± 4%. The limitations on the precision of the calorimetric measurements are temperature drift, noise, and the thermal defect in polythene, and these are discussed in some detail. (auth)

25850 (AED-CONF-74-509-009) THE RESPONSE OF THE FERROUS SULPHATE DOSEMETER TO NEUTRONS. Lawson, R. C.; Porter, D.; Law, J. 1974. 18p. INIS.

From second symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

2 figs.; 4 tabs.; 24 refs. With abstract.

The variation of G-value with neutron energy has been calculated up to 18 MeV by a semi-empirical method which utilized charged particle G-values for "thin target" bombardment conditions and theoretical LET dose distributions for mono-energetic neutron interactions with the dosemeter medium. To test the derived relationship of G-value with neutron energy, measurements were made in two d-t neutron beams a) with minimum scattering material present so that only 13% of the neutron dose was due to low-energy scattered neutrons of mean energy 1.3 MeV, and b) with a uranium block in the beam to increase the low-energy neutron component to about 57% at mean energy 1.5 MeV. In both cases the γ-ray component was only about 5%. The neutron G-values for the two radiation qualities were found to be 9.36 ± 0.16 ± 0.50 and 8.46 ± 0.34 ± 0.44, respectively, where the uncertainties are the estimated root mean square values from random and systematic sources at the 95% confidence level. These were in excellent agreement with the predicted G-values. (auth)

25851 (BARC-762) INDIRECT INTERCOMPARISON OF EXPOSURE STANDARDS. Rao, P. S.; Govindarajan, K. N.; Gupta, U. C. (Bhabha Atomic Research Centre, Bombay (India). Electronics Div.). 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

Transfer chambers are commonly used for indirect intercomparison of exposure standards maintained at several national standards laboratories. The results of calibration of a transfer chamber against the exposure standard maintained in BARC, at ^{60}Co energy are described in detail. The transfer chamber was also calibrated at the International Bureau of Weights and Measures (BIPM), France. The agreement between the calibration factors obtained for this chamber at BARC and BIPM is within 0.3%. (auth)

25852 (KFKI-74-86) THERMOLUMINESCENT DOSIMETER READER TYPE TLD-03. Szabo, B.; Szabo, P. P.; Makra, Z.; Vagvolgyi, J.; Soos, J. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Nov 1974. 17p. (In Hungarian). Dep. NTIS (US Sales Only) $4.00.

A thermoluminescent dosimeter reader was developed. The heating program of the reader can be changed in wide range, the photomultiplier tube is exchangeable. The reader is suitable for measuring the dose, absorbed by different kinds of thermoluminescent materials. The reader is used in the field of personal dosimetry and for research. Measurements with LiF powder and $CaSO_4$: Dy-Teflon discs are described to illustrate the capability of the reader. (auth)

25853 (KFKI-75-1) INVESTIGATION OF PROPERTIES OF $CaSO_4$: Dy THERMOLUMINESCENT DOSIMETERS. Szabo, P. P. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Dec 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

Thermoluminescent properties of $CaSO_4$: Dy-Teflon dosimeters were investigated, and measurements on fading at different temperatures, light sensitivity, and thermal neutron sensitivity were performed. (auth)

25854 (ORNL-TM-4566) TENTH DOSIMETRY INTERCOMPARISON STUDY, AUGUST 27–SEPTEMBER 7, 1973. Dickson, H. W.; Haywood, F. F.; Becker, K. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 59p. Dep. NTIS $6.00.

The tenth in the continuing series of Dosimetry Intercomparison Studies was held from August 27–September 7, 1973. The ORNL Health Physics Research Reactor, operated in the pulse mode, served as the fission source. Three different neutron and gamma spectra were used to simulate nuclear accidents. Detectors used as area monitors, as well as personnel monitoring badges were

intercompared under a set of standard conditions. Results of the experiment indicated that reported values of fast neutron dose were within a standard deviation of 33% for all pulses, while gamma-ray measurements were within ±29% at one standard deviation. (auth)

25855 ABSORBED DOSE MEASUREMENT WITH A CALORIMETER IN A PULSED GAMMA RADIATION FIELD. Kallmeyer, D. H.; Koehn, O.; Roose, U. J. (Institut fuer Naturwissenschaftlich-Technische Trendanalysen (INT), Stohl (F.R. Germany)). Atomkernenergie; 24: No. 3, 203-207(1974).

7 figs.; 2 tabs.; 9 refs.

A semiadiabatic microcalorimeter operating at liquid nitrogen temperature is described to measure the absorbed dose in lead, silicon and aluminum. The absorbed dose versus the distance calorimeter-radiation source is presented. The described measurement technique draws importance from the fact that it is an absolute and direct method to measure the absorbed dose that a gamma radiation field of unknown spectrum deposits in a certain absorbing material. The spectrum independent and absolute measurement is achieved by calibrating the measured quantities directly with a precisely determined amount of electric energy. The range of the reported measurements extends from approximately 0.5 to 1,000 rad. (auth)

25856 AN AUTOMATIC SYSTEM FOR THE RECOGNITION AND COUNTING OF TRACES IN FAST NEUTRON FILM-BADGES. Paretti, C.; Ricci, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nucl. Instrum. Methods; 122: No. 3, 389-397 (15 Dec 1974).

This paper describes the design of a special-purpose electronic unit for the recognition and counting of rectilinear traces present in film-badges for fast neutrons and having an isotropic angular distribution. The unit has been especially designed for measurements in the presence of high X- or γ-ray background. The system consists of a microscope, a servo-mechanism which controls the movements of the microscope stage for the mechanical scanning of the film, a TV camera for the optical-electronic scanning of the images, a unit for the identification and counting of the traces, and a data printer. Identification is based on a numerical type logic and is performed on the electrical signals emitted by the camera which are sampled, digitalized and memorized. Suitable filtering operations are performed to eliminate signals due to X or γ background or to spots present in the film. The design was tested by means of an IBM 360/75 computer and gave excellent results. (auth)

25857 LATENT IMAGE STABILITY IN KODAK RM FILMS USED IN PERSONNEL DOSIMETRY. Gibson, J. A. B.; Brown, A. R.; Docherty, J. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Phys. Med. Biol.; 19: No. 6, 874-878(Nov 1974).

The stability of the image of both the emulsions of the Kodak RM film stored in humidities between 0 and 100% R. H., and at temperatures of 10, 22, and 30°C was examined, together with the effect of variations in the radiation quality. The errors resulting from fading were assessed with reference to the routine procedures for exposure of control films in personnel dosemeters issued for 28-day or 14-day periods. The results showed that even at 76% relative humidity the maximum error (approximately 20%) was small compared to the uncertainties implicit in the extrapolation of the dose measured by any small personal dosemeter to that received by the whole body. (UK)

25858 DOSIMETER LATCH. Basso, M. J.; Kronemberg, S. (to Secretary of the Army). US Patent 3,868,511. 25 Feb 1975. Filed Date 4 Apr 1974. 6p.

A pen size dosimeter designed to be viewed longitudinally for reading dosage of neutron radiation and gamma radiation and that is reset by being charged through a conductor pin carried by a longitudinally compressible spring urged assembly near one end of the dosimeter but which may lose the correct dosage reading under shock and vibration conditions is improved by the addition of a novel latch for the spring-urged assembly to release the spring urged assembly to permit displacement for charging and to relatch when charging is terminated. (Official Gazette)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 25203, 26586, 27791, and 28781.

25859 (AED-CONF-74-509-026) COMPARISON OF DIFFERENT NEUTRON SPECTROMETERS FOR THE ENERGY RANGE 0.1-10 MeV. Bluhm, H.; Rusch, D.; Werle, H.; Korthaus, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). 1974. 14p. (In German). INIS.

From second symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

4 figs.; 1 tab.; 19 refs. With abstract.

The following spectrometers were individually used: NE 213-liquid scintillators with γ-n discrimination; gas-filled (H_2,CH_4,^4He). cylindrical and spherical recoil proportional counter tubes or ionization chambers and γ-discriminating ^3He-semiconducting sandwich spectrometer. The measured results of the spectrometers were compared with one another and with the results of other laboratories for various systems in order to obtain indications on reliability, accuracy and systematic errors. By means of these measurements, the properties of the spectrometer (sensitivity, energy resolution, accuracy) are discussed and their suitability for two frequently occurring types of fields (directed beam, all-round neutron incidence) are investigated. (auth)

25860 (BARC-775) MOESSBAUER SPECTROMETER WITH DIGITALLY CONTROLLED FUNCTION GENERATOR. Indurkar, V. S.; Patwardhan, P. K. (Bhabha Atomic Research Centre, Bombay (India). Electronics Div.). 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

Moessbauer spectrometers are presently being used in widely different fields. The choice of a suitable velocity transducer differs widely for these applications. A versatile Moessbauer spectrometer is described, with three different velocity transducers which are well-suited for different types of experiments. A digitally controlled function generator used in this spectrometer is a self-contained unit driven by a crystal controlled oscillator. It does not depend upon Multichannel Analyzer (MCA) for its cycle of operation. Thus it can be used in constant velocity mode or scanning velocity mode. This results in a good synchronization and stability of operation. This Moessbauer spectrometer is compatible with several types of MCA's available presently. (auth)

25861 (INT-60/E) SCINTILLATION BOREHOLE GAMMA-RAY SPECTROMETER. Palka, K. W. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). 1974. 66p. (In Polish). Dep. NTIS (US Sales Only) $6.50.

The stabilized scintillation spectrometer with 128 channels is described. This instrument is designed for the borehole measurements of the gamma-ray energy ranging from 200 keV to 10 MeV. The linear code for signal transmission through logging cable is used. Maximum operation temperature of the probe and the dead time are 60°C and 1.4 ms, respectively. The results of the preliminary borehole measurements are presented. (auth)

25862 (KFK-2021) EXPERIMENTAL AND THEORETICAL ASPECTS OF HIGH RESOLUTION NEUTRON SPECTROSCOPY. Cierjacks, S. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Apr 1974. 29p. (AED-CONF-74-567-001). INIS.

From second international school on neutron physics; Alushta, Crimea, USSR (2 Apr 1974).

16 figs.; 2 tabs.; 25 refs. With abstract in English and German.

Present experimental conditions for high-resolution neutron spectroscopy are discussed on the basis of recent developments in neutron spectrometers using a continuous energy spectrum source. Particular consideration is given to the isochronous cyclotron time-of-flight spectrometer. As an example of this type of facility, the fast neutron spectrometer at the Karlsruhe cyclotron is briefly described. Present specifications of the time-of-flight apparatus are given. To demonstrate its capability for high-resolution neutron investigations, a few examples of recently obtained results are given. Some theoretical aspects of high-resolution neutron spectroscopy are considered in some detail. A new method is discussed which allows an unambiguous assignment of resonance spins and parities by combining results from both high-resolution total and a few angle elastic scattering experiments. The implications of this method on the determination of accurate resonance parameters are examined. The appearance of intermediate structure phenomena in fast neutron excitation functions is demonstrated. Its possible interpretation in terms of door-way structure is discussed. (auth)

25863 (LF-57) CONVERSION OF THE PULSE SPECTRUM FROM A ^3He-NEUTRON SPECTROMETER TO A TRUE NEUTRON ENERGY SPECTRUM. Rudstam, G. (Forskningsraadens Lab., Studsvik (Sweden)). 1974. 16p. Dep. NTIS (US Sales Only) $4.50.

A ^3He-neutron spectrometer was used in an extensive study of the energy distribution of delayed neutrons from mass-separated fission products at the OSIRIS-facility at Studsvik. The spectrometer yields a pulse spectrum which has to be converted to a true neutron energy spectrum using the known response function of the spectrometer. In order to carry out this conver-

sion a computer code SPECTRANS has been developed. This code is described in the present report. (auth)

25864 CALCULATION OF THE SPECTRA OF CdTe DETECTORS. Skrivankova, M. (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 21: No. 1, 23-26(In Czech).

The article deals with the calculation of γ-spectra of CdTe detectors with respect to the properties of the basic material. Expressions are given which were used for the calculation, including some illustrative examples and comparisons with experimental values. Possibilities are analyzed for using CdTe detectors for testing nuclear fuels. (auth)

25865 VERSATILE MULTIPLE MOESSBAUER SPECTROMETER. Window, B.; Dickson, B. L.; Routcliffe, P.; Srivastava, K. K. P. (Australian National Univ., Canberra). J. Phys., E (London); 7: No. 11, 916-921(Nov 1974).

A Moessbauer spectrometer system, based on a PDP 11/10 minicomputer and capable of accumulating up to eight simultaneous spectra, was designed and constructed. The system allows the data in each spectrum to be handled without interference to the other accumulating spectra. The computer is used to generate the velocity reference signal, removing the need for a separate waveform generator, and enabling a very smooth waveform to be calculated and used. (auth)

25866 CONTEMPORARY METHODS AND TESTS IN THE STUDY OF THE ENERGY DISTRIBUTION OF NEUTRONS IN EXPERIMENTS ON NUCLEAR REACTORS. Egorov, Yu. A.; Pankrat'ev, Yu. V. Vop. Fiz. Zashch. Reaktorov; No. 6, 135-146(1974). (In Russian).

A review is presented of the methods used for the measurement of reactor neutrons. Scintillation spectrometers, ^{3}He spectrometers, H spectrometers, and threshold detectors are discussed. The simultaneous use of these four types of neutron detectors makes it possible to measure the energy distribution of neutrons from 0.46 eV to 12 MeV. (55 references) (JSR)

25867 MEASUREMENT OF THE ENERGY DISTRIBUTION OF NEUTRONS OF DIFFERENT FORMS WITH A SINGLE-CRYSTAL SCINTILLATION SPECTROMETER. Trykov, L. A. Vop. Fiz. Zashch. Reaktorov; No. 6, 146-152(1974). (In Russian).

In physical experiments, the measured neutron spectra can be divided into three forms: smooth, smoothly changing, and line. The spectra of fission neutrons, spectra of isotopic sources, and spectra from reactions such as Be(d,n) are representative of each of these forms. The possibility of using a single-crystal scintillation spectrometer for the measurement of each form of neutron spectrum was studied experimentally. The method of smoothing differentiation can be used for the transformation of the apparatus distribution into the energy spectrum of neutrons of different form. For the measurement of the neutron spectrum for energies E > 0.4 MeV by crystals with a thickness no greater than 10 to 15 mm the errors caused by multiple scattering of the neutrons in the crystal can be neglected. Neutron spectra of the fission and line type are the most sensitive to distortions arising from the multiple scattering of neutrons on the crystal. (JSR)

25868 USE OF A HYDROGEN SPECTROMETER FOR INVESTIGATION OF THE NEUTRON SPECTRA IN REACTOR SHIELDING MATERIALS. Badyaev, V. V.; Egorov, Yu. A.; Kulagin, V. A.; Pankrat'ev, Yu. V. Vop. Fiz. Zashch. Reaktorov; No. 6, 152-158 (1974). (In Russian).

The possibility of using a hydrogen-filled proportional counter included in the spectrometer circuit for the study of the energy distribution of neutrons in shielding materials in good geometry was studied. The operational characteristics of the spectrometer were confirmed by measurement of the spectra of unscattered neutrons passing through Fe, Ti, and Al and by measurement of the neutron spectrum in Fe in conditions of semi-infinite geometry. The results obtained were compared with data from other types of measurements showed that the spectrometer can produce satisfactory data on the energy distribution of neutrons in the energy region above ~5 keV. (JSR)

25869 MATRIX METHOD FOR THE PROCESSING OF NEUTRON SPECTRA MEASURED BY A ^{3}He-SPECTROMETER IN MATERIALS OF THE BIOLOGICAL SHIELD. Egorov, Yu. A.; Zharkov, V. P.; Orlov, Yu. V. Vop. Fiz. Zashch. Reaktorov; No. 6, 172-175(1974). (In Russian).

The errors arising in the processing of neutron spectra measured with ^{3}He spectrometers using experimental matrices are discussed. The amplitude distribution for ^{3}He spectrometers was calculated by the Monte Carlo method to confirm the accuracy of experimental matrices and to expand the dynamic region of the spectrometer. The direct and inverse matrices obtained are tabulated for the energy region for 0 to 2.5 MeV in steps of 50 keV. The energy distributions of neutrons obtained by calculation and experimental matrices are compared. Disagreements between calculated and experimental matrices are found at high energies. (JSR)

25870 MONTE CARLO CALCULATION OF THE APPARATUS LINE FORMS FOR NEUTRON ^{3}He SPECTROMETERS. Egorov, Yu. A.; Zharkov, V. P.; Orlov, Yu. V. Vop. Fiz. Zashch. Reaktorov; No. 6, 175-182(1974). (In Russian).

A method of calculating the line forms of a ^{3}He spectrometer by means of a Monte Carlo statistical testing method is described. The physical scheme of the calculation is outlined, and the selection of the nuclear-physical constants is discussed. Comparison of the experimental line forms with the calculated forms shows good agreement. (JSR)

25871 ANALYSIS OF THE PULSE-HEIGHT SPECTRA DISTORTION CAUSED BY THE PILE-UP EFFECT. Fedotov, S. N.; Volkov, N. G. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). Nucl. Instrum. Methods; 122: No. 3, 463-465(15 Dec 1974).

A method is developed to calculate the distortion of the pulse-height spectra by the pile-up effect in spectrometric circuits. An expression for the distorted spectrum is given, the analyzer dead time being taken into account. The distortion is computed using the fast Fourier transformation. The experimental and the corresponding computed distorted spectra are compared and good agreement is obtained. The method can be used for arbitrary spectra and pulse shapes. (auth)

25872 A PASSIVE NEUTRON SPECTROMETER USING A NUCLEAR TRACK DETECTOR. Frank, A. L.; Benton, E. V.; Albergotti, J. C. (San Francisco Univ., Calif. (USA). Dept. of Physics). Nucl. Instrum. Methods; 122: No. 3, 433-441(15 Dec 1974).

A detector has been developed for the spectral measurement of neutrons over a fluence range of approximately 1.5×10^8 to 5×10^{11} neutrons/cm^2 and in the energy range between 3 and 20 MeV. The detector consists of a radiator whose nuclei are elastically scattered by neutrons, a degrader which reduces the energies of recoil nuclei transmitted through it, and a recorder capable of registering the tracks of energetic recoil nuclei. The detector offers the advantages of compactness, stable sensitivity, permanence of recorded data, and insensitivity to background radiations. There are no flux effects present or limitations due to reaction half-lives. Computer programs have been developed for calculating response from detector parameters (FLUENZ), for determining the angular response of the detector (SLANT), and for the unfolding of neutron spectra (HENDU). (auth)

25873 ON THE USE OF TIN-LOADED PLASTIC SCINTILLATORS IN MOESSBAUER SPECTROSCOPY. Becker, J.; Ericksson, L.; Moberg, L. C. (Stockholm Univ. (Sweden). Fysiska Institutionen); Cho, Z. H. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). Nucl. Instrum. Methods; 123: No. 1, 199-201(1 Jan 1975).

The relative total absorption efficiencies for 14.4 and 23.9 keV gamma rays detected in tin-loaded (NE 140) and unloaded (NE 102) plastic scintillators have been determined. The possibilities to use NE 140 scintillators in Moessbauer spectroscopy have been investigated. It was found that the short decay time and the high efficiency for low gamma energies make the NE 140 scintillator ideal in high count rate Moessbauer experiments, where the accepted transition is well separated from other contributions in the energy spectrum. (auth)

25874 AN ASPECT OF THE USE OF A SPECTRAL NEUTRON INTENSITY STANDARD. Lefevre, H. W.; Burke, C. A. (Oregon Univ., Eugene (USA). Dept. of Physics). Nucl. Instrum. Methods; 122: No. 3, 351-352(15 Dec 1974).

The effect of neutron detector bias variations on the low energy (E_n < 250 keV) portion of a neutron time-of-flight spectrum from ^{7}Li(p,n)^{7}Be in a thick metal target, is empirically described in a simple way. (auth)

25875 NUCLEAR LIFETIME MEASUREMENTS WITH AN ON-LINE ELECTRON SPECTROMETER. Canty, M. J.; Debenham, P. H.; Dohan, D. A.; Skalsey, M.; Watson, J. W. (Manitoba Univ., Winnipeg (Canada). Cyclotron Lab.). Nucl. Instrum. Methods; 122: No. 3, 547-552(15 Dec 1974).

The performance of a single-gap electron spectrometer for in-beam isomeric lifetime measurements on the University of Manitoba Cyclotron is described. Conversion electrons following (p,xn) reactions are detected in delayed coincidence relative to the 28 MHz proton beam bursts. An overall resolving time of 770 ps fwhm is achieved for 345 keV electrons produced in the ^{197}Au(p,2ne$^-$)^{196}Hg reaction. A determination of the half-life of the 1911 keV isomeric state in ^{196}Hg yields $T_{\frac{1}{2}}$ = (4.46 ± 0.11) ns. (auth)

25876 DISCUSSION ON OPTIMUM FILTERING IN NUCLEAR RADIATION SPECTROMETERS. Koeman, H. (Philips Gloei-

lampenfabrieken N. V., Eindhoven (Netherlands)). Nucl. Instrum. Methods; 123: No. 1, 161-167(1 Jan 1975).

Assuming ideal detector properties and the noise power density function of the input circuitry of the preamplifier, the relation between signal-to-noise ratio and counting losses is discussed. The transversal digital filter can adapt its response function to the time intervals between signals. The adaptive filter properties described automatically match in an almost optimum way signal-to-noise ratio and counting losses. (auth)

25877 PRINCIPLE OF OPERATION AND PROPERTIES OF A TRANSVERSAL DIGITAL FILTER. Koeman, H. (Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands)). Nucl. Instrum. Methods; 123: No. 1, 169-180(1 Jan 1975).

The principle of operation is described and signal-to-noise ratios, obtained with a special type of digital filtering techniques applied to nuclear radiation spectrometry are calculated. (auth)

25878 PRACTICAL PERFORMANCE OF THE TRANSVERSAL DIGITAL FILTER IN CONJUNCTION WITH X-RAY DETECTOR AND PREAMPLIFIER. Koeman, H. (Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands)). Nucl. Instrum. Methods; 123: No. 1, 181-187(1 Jan 1975).

The practical performance of a transversal digital filter was tested in conjunction with a 25 mm^2 Si(Li) X-ray detector with preamplifier and cryostat supplied by Philips Elcoma Nuclear Devices Division. The radioactive source used for testing the system was a 20 mCi ^{55}Fe source emitting 5.894 keV K_α and 6.489 keV K_β energy lines. The maximum intensity of the radiation was, if the source was placed close to the detector, approximately 900,000 events per second. (auth)

25879 PROPERTIES OF A TIME-OF-FLIGHT TELESCOPE FOR HEAVY IONS IN THE A = 100 RANGE. Schneider, W. F. W.; Kohlmeyer, B.; Pfeffer, W.; Puehlhofer, F.; Bock, R. (Marburg Univ. (F. R. Germany). Fachbereich Physik). Nucl. Instrum. Methods; 123: No. 1, 93-98(1 Jan 1975).

Properties of a time-of-flight telescope have been studied with iodine, bromine and lighter ions in the energy range from 1 to 2.4 MeV/amu. A system detecting secondary electrons emitted from a 10 to 20 $\mu g/cm^2$ thick carbon foil by an open multiplier was used as zero-time detector. It shows an improving time resolution for ions with higher mass (250 ps for iodine), which cause a higher secondary electron yield. Strong degradation of timing characteristics of the surface barrier stop detector was observed at an integrated dose of about 10^9 iodine ions/cm^2. Further applications of the time-of-flight technique, as the possibility of achieving a Z-identification with a double flight time measurement and a better energy resolution using the time-of-flight information are discussed. (auth)

25880 A HYBRID TIME-OF-FLIGHT SPECTROMETER FOR THERMAL NEUTRON SCATTERING. Olsson, L. G.; Dahlborg, U.; Groenros, M.; Karlsson, L. E.; Larsson, K. E.; Maansson, T. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Nucl. Instrum. Methods; 123: No. 1, 99-104(1 Jan 1975).

A new time-of-flight spectrometer utilizing thermal neutrons has been installed at the 50 MW R2-reactor in Studsvik. A double crystal arrangement is used to select monochromatic neutrons from the reactor beam. The (220)-reflexion from copper crystals allows a continuous wavelength variation within the limits 2.2 Å and 0.9 Å. The pulsing of the neutrons as well as the suppression of higher order Bragg-scattering is performed by a high-speed Fermi chopper with curved slits. The detector system consists of forty helium counters which can be placed at variable distances from the sample. Each counter has its own amplifier thus making it possible to choose the number of detector tubes per angle of observation according to the needed counting intensity, angular resolution, etc. The data-handling system includes a time-analyser unit, a mini-computer and a disk, on which the experimental data are stored during the various processing routines, and it is designed to serve three time-of-flight spectrometers simultaneously. Considering an acceptable intensity the following preliminary values of the total wavelength resolution of the spectrometer have experimentally been established: 1.8, 2.0, and 2.6% at the incident neutron wavelength 1.8, 1.5, and 1.3 Å, respectively, and a flight-path of 1.6 m. (auth)

25881 RESPONSE FUNCTIONS OF A 4π Si(Li) SEMICONDUCTOR SPECTROMETER FOR ELECTRONS. Schuepferling, H. M. (Stuttgart Univ. (TH) (F. R. Germany)). Nucl. Instrum. Methods; 123: No. 1, 67-71(1 Jan 1975).

For precise unfolding of β-spectra it is necessary to use realistic non-Gaussian response functions. These response functions have been measured for three different energies (62 keV, 364 keV and 624 keV) using K conversion electrons in coincidence with K X-rays. It can be shown that the response function is asymmetric and is therefore distorting a continuous spectrum in a different way than a simple Gaussian function does. A simulation of the response function by a Monte Carlo method shows that the asymmetries cannot be caused by the detector window, the source thickness, or by bremsstrahlung, for the consideration of these effects results only in symmetric response functions with a small second peak at lower energies. (auth)

25882 PEAK POSITION VARIATION WITH SOURCE GEOMETRY IN Ge(Li) DETECTOR SPECTRA. Helmer, R. G.; Gehrke, R. J.; Greenwood, R. C. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nucl. Instrum. Methods; 123: No. 1, 51-59(1 Jan 1975).

Shifts in the apparent energy of peaks in gamma-ray spectra from Ge(Li) detectors have been measured as a function of the source-detector geometry for several detectors. For a planar detector, the change in the apparent peak energy was measured between gamma rays entering parallel and perpendicular to the electric field. With a bias of 237 V/mm, a shift of ~250 eV was observed for a 2500 keV gamma ray. For a planar and five coaxial detectors, the shift in peak energy was measured as a function of the source-detector distance. For a gamma ray of 1500 keV, the shifts were from >100 eV to –90 eV for the six detectors in going from a source-detector distance of 35 cm to 1 cm. The larger of these shifts could introduce significant systematic errors in precise gamma-ray energy difference measurements. This effect is presumed to result from (1) the acceleration of electrons due to the detector bias and (2) variation in the charge collection efficiency over the detector volume. (auth)

25883 A β–γ-CIRCULAR POLARIZATION CORRELATION APPARATUS WITH A LINEAR ELECTRON ACCELERATOR. Farman, M.; Loose, R.; Rechenberg, H. V.; Schneider, H. (Giessen Univ. (F. R. Germany). Abt. Grossgeraete). Nucl. Instrum. Methods; 122: No. 3, 369-371(15 Dec 1974). (In German).

A thyristor-controlled fast Compton polarimeter is described. Combined with a linear accelerator, the experimental set-up will be used to measure isospin-forbidden Fermi transitions. (auth)

25884 EVALUATION OF A COMMERCIAL ^3He SEMICONDUCTOR SPECTROMETER FOR MEASUREMENT OF EXTERNAL REACTOR NEUTRON SPECTRA. Yang, T. L.; Lin, T. S. (Department of Nuclear Engineering, National Tsing Hua University, Hsinchu, Taiwan, Republic of China). Nucl. Instrum. Methods; 122: No. 3, 353-363(15 Dec 1974).

The neutron spectrum outside a reactor beam port has been measured by using a ^3He semiconductor neutron spectrometer. Only neutrons between 2 and 10 MeV can be obtained. The spectrum falls off exponentially above 6 MeV. Some characteristics such as bias voltage versus pulse height, low signal-to-noise ratio, counting efficiency versus ^3He pressure and radiation damage have been reported. Energy calibration can be made with thermal neutrons by the characteristic peaks of 0.573 MeV protons and 0.764 MeV Q-value instead of monoenergetic neutrons from a Van de Graaff accelerator. (auth)

25885 PRIKLADNAYA YADERNAYA SPEKTROSKOPIYA. (Applied Nuclear Spectroscopy). Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). 394p.

Material from the XXII and XXIII Annual All-Union Conferences on Nuclear Spectroscopy and Structure of Atomic Nuclei is compiled. Articles on the study of the basic characteristics of radiation sources and their uses, study and improvement of semiconductor radiation detectors, production of new types of detectors, use of spectrometric installations for the solution of various problems, stabilization of spectrometers, and methods for the processing and analysis of results are presented. Separate abstracts were prepared for 40 of the articles. (166 figures, 33 tables, 303 references) (JSR)

For abstracts of individual papers see: 25200–25204, 25234, 25346, 25666, 25832–25837, 25886–25899, 25909, 25976, 25977, 25986, 26300, 26382, 26551, 26579, 26931, 27571, 27626, and 27786.

25886 POSSIBILITIES OF A NEW METHOD OF STUDYING γ TRANSITION SCHEMES: QUANTITATIVE ANALYSIS OF ANTICOINCIDENCE SPECTRA. Burmistrov, V. R. pp 77-89 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The method of quantitative analysis of the spectra of Ge(Li) detectors in anticoincidence with large NaI(Tl) crystals was studied with respect to its practical use for the analysis of energy levels and γ transitions. The principles of the method are described and the necessary calculations are given. As an example of the utility of the method, it was applied to the study of the γ transitions during the decay of ^{115}Cd. The results are compared with those obtained by previous investigators. The advantages and disadvantages of the method are investigated. (JSR)

25887 USE OF A SCINTILLATOR–PHOTODIODE SYSTEM IN NUCLEAR SPECTROMETRY. Stolyarova, E. L.; Drygin, V. N.; Samedov, V. V. pp 90-98 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

Experimental studies on the use of photodiodes in the place of photomultipliers are reviewed. The data are difficult to compare because of the lack of complete information on experimental conditions. However, the available data indicated their possible use, especially for high-energy heavy particles. The use of photodiodes is preferable in those cases where evaluation of the energy group of the radiation is sufficient. Photodiodes are suitable for use in magnetic fields. It appears possible to improve the parameters of the scintillator–photodiode system and attain resolutions close to that possible with a scintillator–photomultiplier system. Miniature avalanche photodiodes are very suitable in laser techniques because of their small dimensions. (JSR)

25888 LARGE-AREA SPECTROMETRIC SURFACE-BARRIER DETECTORS. Solov'ev, S. M.; Eismont, V. P. pp 99-104 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

Two large-area surface barrier detectors with a sensitive area of 8.5 and 10 cm^2 were prepared from Si without dislocations. The energy resolution of the detectors was tested on $^{238}Pu + ^{239}Pu$ sources at room temperature and –150°C. The resolution was almost completely temperature independent. These detectors are primarily applicable to the measurement of spectra of low-activity targets. (JSR)

25889 LOW-ENERGY TAIL IN SEMICONDUCTOR DETECTOR OF α PARTICLES. Donichkin, A. G.; Solov'ev, S. M.; Eismont, V. P. pp 111-115 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

In the amplitude distribution of pulses from α particles incident on semiconductor detectors there is a low-energy tail whose intensity is about 1% of the integral value and changes slightly with energy. The effect of the material of the detector, the material of the source support, and the material of the iris on the size of the tail was studied using Si surface-barrier detectors with different specific resistances and ^{238}Pu and ^{241}Am sources deposited on different supports. The results obtained are tabulated and show that the counting precision does not depend on the detector. The precision can be improved by careful processing of the iris and by the use of sources on thin supports. (JSR)

25890 MOSAIC-TYPE DETECTOR CONSISTING OF SEMICONDUCTOR DETECTORS. Reznik, V. R.; Terent'ev, N. K.; Shashmin, V. E. pp 116-122 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

During the measurement of the energy of heavy charged particles by the time-of-flight method using Si surface-barrier detectors, one of the basic problems is the increase of the detector surface while maintaining good energy and time resolution. In the present study, this problem was solved by the use of semiconductor mosaic-type detectors. With appropriate electronic devices and methods of connecting elements, signals can be obtained from one detector and simultaneously from all detectors forming the mosaic. Functional circuits for a mosaic detector and the electronic equipment are given. Typical spectra obtained with 36-detector and 3-detector mosaics are shown. (JSR)

25891 SUM COINCIDENCE SPECTROMETER WITH SEMICONDUCTOR DETECTORS. Aloev, A. S.; Vartanov, N. A.; Kazakov, Yu. E.; Stugarev, Yu. N. pp 123-128 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

A sum coincidence spectrometer in which large volume Ge(Li) detectors are used in the detection units is described. Structural designs of spectrometers with slow and with fast sum coincidences are given. Gamma spectra of ^{60}Co with summation of the pulses from two Ge(Li) detectors, slow summation coincidence, and fast-slow summation coincidence are shown. (JSR)

25892 COMPTON COINCIDENCE SPECTROMETER WITH INTEGRATION OF PULSES FROM TWO Ge(Li) DETECTORS. Aloev, A. S.; Vartanov, N. A.; Kazakov, Yu. E.; Stugarev, Yu. N. pp 129-138 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

If semiconductor Ge(Li) detectors are used in Compton coincidence spectrometers significantly simplified forms of the instrumental lines can be obtained because of the different energy resolution of the two detectors. The structural plan of this type of spectrometer with summation of the pulses from two Ge(Li) detectors is given. The γ spectra of ^{54}Mn, ^{137}Cs, a mixture of these two isotopes, ^{60}Co, and ^{137}Cs obtained with a Compton coincidence spectrometer are given and compared with the spectra obtained with a single crystal. The effect of cascading on the results obtained are shown for ^{60}Co. (JSR)

25893 CALCULATION OF A SPECTROMETRIC IONIZATION CHAMBER WITH CYLINDRICAL ELECTRODES. Yakunin, M. I. pp 139-148 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

Formulas were derived for the calculation of the geometric and physical conditions of an ionization chamber with cylindrical electrodes. The pulse amplitudes of an α spectrometer using this type of ionization chamber were calculated from the formulas. The characteristics of a chamber for use with sources having an active surface area up to 4200 cm^2 were calculated. (JSR)

25894 AUTOMATIC SYSTEM FOR DEMAGNETIZING THE MAGNETIC PRISMS OF THE UNIVERSAL MAGNETIC BETA SPECTROMETER. Barkov, A. V.; Vinogradov, V. M.; Zolotavin, A. V.; Shlyakhtenko, P. G. pp 186-189 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

A system for the automatic demagnetization of magnetic prisms was developed with which it is possible to transmit through the coils of the electromagnet, currents of alternately reverse directions with a decrease of the maximum current after each direction change of 5% from the previous one. A block diagram of the system and its principal circuits are given. (JSR)

25895 USE OF COMPUTERS FOR CLASSIFICATION OF DATA OBTAINED IN (E–ΔE) SPECTROMETERS WITH NON-INTEGRATING TYPE RECORDERS. Kuritsyn, V. N.; Shibaev, V. A. pp 211-216 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The basic theorems of the method of data classification for study of reactions of the (n, charged particle) type are outlined. The selection of the approximation functions for distribution according to ΔE is discussed. The determination of the boundaries of the range of protons is described. The steps in the process of separation of regions corresponding to protons and the subsequent data classification are outlined. (JSR)

25896 PULSE FORM OF A NEUTRON SPECTROMETER WITH CRYSTALLINE SCINTILLATOR. Trykov, L. A.; Tyufyakov, N. D. pp 229-240 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

During the alignment and operation of neutron spectrometers in the presence of γ radiation, it was assumed that the pulse form of the detector (often an organic scintillator) depended only on the form of radiation. However, experiments have indicated that in organic crystalline scintillators there is, in addition to this dependence, a dependence of the pulse form on the relative direction of motion of the same type radiation in the scintillator. The results of the experiments carried out on scintillators of stilbene, anthracene, and naphthalene using neutrons, γ radiation, and α particles that confirm this second dependence are reported. Some possibilities for the practical use of this effect are discussed. (JSR)

25897 ION OPTICS AND CONSTRUCTION OF A WIDE-RANGE MAGNETIC SPECTROMETER WITH STEPPED POLES. Basargin, Yu. G.; Bogdanov, P. V.; Boldin, N. I.; Gofman, Yu. F.; Maidikov, V. Z.; Rozhdestvenskii, B. V.; Severgin, Yu. P.; Suvorov, M. M.; Sudarushkin, A. S. pp 253-257 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The ion optics system of two small spectrographs constructed at the Institute of Nuclear Research of the Ukraine is briefly described. The parameters of the system are calculated for different orbit radii. The special construction features are briefly indicated. (JSR)

25898 MULTIDIMENSIONAL MEASUREMENTS ON THE MINSK-22 COMPUTER IN PROBLEMS OF NUCLEAR SPECTROSCOPY. Vylov, Ts.; Zaidler, Z.; Zvol'ski, I.; Kondrat, E. T.; Kuznetsov, V. V.; Morozov, V. A.; Fominykh, M. I.; Fominykh, V. I.; Tsupko-Sitnikov, V. M. pp 269-281 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The digital window method is used for multidimensional measurements with the Minsk-22 computer. The complex of instrumentation used in making multidimensional measurements is illustrated by the structural circuit for a three-dimensional analyzer of ($\gamma\gamma$-t) coincidences. The setting up of a measurement regime with preliminary formulation of the scale is outlined. Background factors to be considered during the analysis of data on $\gamma\gamma$ coincidences are discussed. The application of the complex

to the measurement of $\gamma\gamma$ coincidences in short-lived isotopes is described. (JSR)

25899 TESTS ON THE USE OF DOMESTIC PHOTODIODES FOR THE REGISTRATION OF SCINTILLATION. Stolyarova, E. L.; Drygin, V. N.; Samedov, V. V. pp 282-283 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

Preliminary results obtained in the testing of a scintillator–photodiode system in spectrometers using domestic crystals and photodiodes are reported. The experimental arrangement is briefly described and the α particle spectrum of ^{241}Am obtained is shown. During these preliminary tests the signal/noise ratio increased. (JSR)

25900 KLEST AMPLIFIER EXPANDER IN A SPECTROMETER FOR SOFT X RADIATION. Nikonenkov, N. V.; Smirnov, V. N. (Inst. of Metal Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1213-1214(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 217(1974).

An external charge preamplifier is described which operates jointly with the "Klest" amplifier expander. Its use allows expansion of the energy range that can be recorded by means of Si(Li)- and Ge(Li)-semiconductor detectors on the soft x radiation side up to 10 keV. The spectrometer energy resolution obtained with respect to the generator is approximately 2 keV at room temperature of the input stage. (auth)

25901 STUDY OF THE BEHAVIOR OF MIRROR ELECTROSTATIC ANALYZERS IN THE CASE OF ENERGETIC PARTICLES. Prange, R. (CNRS, Verriere le Buisson, France). Rev. Sci. Instrum.; 46: No. 3, 278-280(Mar 1975).

Three models of electrostatic mirror analyzers were studied and it is shown that these instruments are inadequate to analyze energetic particles because they require too high retarding voltages compared to the mean energy of the particles analyzed. (auth)

25902 SIMPLE SINGLE AND TANDEM MICROCHANNELPLATE MOUNTINGS FOR X-UV OR LOW ENERGY PARTICLE WINDOWLESS IMAGE CONVERTERS. Bettinali, L.; Pecorella, F.; Rager, J. P. (CNEN-EURATOM, Frascati, Italy). Rev. Sci. Instrum.; 46: No. 3, 322-323(Mar 1975).

Details are given for the realization of a windowless image converter for low-energy particle or soft x-ray spectroscopy, based on the use of new microchannelplate mountings in which the electrical contacts are secured by small spring loaded pin-contacts. Among other improvements, this mounting can match any microchannelplate thicknesses and can easily be extrapolated to the case of tandem microchannelplate mounting. (auth)

High Energy Physics Instrumentation

Refer also to abstracts 26589, 26593, 26595, 26597, and 27228.

25903 (CONF-720923-P4, pp 321-331) NEW EXPERIMENTAL CAPABILITIES AND POTENTIALITIES IN HIGH ENERGY PHYSICS. Willis, W. J. (Yale Univ., New Haven). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 4.

The program in the techniques of particle detection and the design of accelerators and storage rings is reviewed with particular emphasis on the opportunities which are being opened for the exploration of areas of physics beyond the ISR which have been inaccessible. These technical developments are considered in the light of the physics which they make possible. (JFP)

25904 A COMPUTER-CONTROLLED TEST SYSTEM FOR MWPC ELECTRONICS. Bozzo, M.; Ogilvie, J.; Vanuxem, J. P. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 122: No. 3, 599-603(15 Dec 1974).

A system has been built to perform the semi-automatic testing of ~10,000 channels (amplifiers and their associated logic circuits) to be used for MWPC read-out. The linear characteristics and the logic functions for each channel are checked using a computer with a CAMAC interface, a number of standard CAMAC and NIM modules, and a few specifically designed units. (auth)

25905 EVENT IDENTIFICATION IN BUBBLE CHAMBER DATA ANALYSIS. Nakamura, M. (Fukui Univ. (Japan). Faculty of Engineering). Nucl. Instrum. Methods; 122: No. 3, 611-613 (15 Dec 1974).

Formulae are given for calculating Bayesian a posteriori probabilities of competing reaction hypotheses for each measured event with the 4C–4C or the 1C–1C ambiguities. (auth)

25906 A BREMSSTRAHLUNG-IDENTIFICATION TECHNIQUE FOR COSMIC-RAY ELECTRONS AND POSITRONS. Buffington, A.; Orth, C. D.; Smoot, G. F. (California Univ., Berkeley (USA). Space Sciences Lab.). Nucl. Instrum. Methods; 122: No. 3, 575-585(15 Dec 1974).

A new technique is introduced to separate energetic e^+ and e^- from a background of other particles. The technique utilizes a selective trigger, radiation of bremsstrahlung photons by incident $e^\pm$, magnetic deflection of the $e^\pm$ after photon emission, and the separate detection of both the $e^\pm$ and the photons in a shower detector. Descriptions are given of a balloon-borne apparatus using this technique for cosmic-ray $e^\pm$ spectral measurements in the energy range from 5 to 50 GeV. Calibrations of the apparatus at particle accelerators and the method of flight data analysis are also described. The balloon-borne apparatus provides an efficiency of about 50% for the detection of $e^\pm$ and a proton rejection of about 10^{-5}. (auth)

25907 ZGE: A PROCESSOR FOR TRACK RECOGNITION ON BUBBLE CHAMBER PICTURES. Hertzberger, L. O.; Harting, D.; Holthuizen, D. J. (Amsterdam Univ. (Netherlands). Zeeman Lab.). Nucl. Instrum. Methods; 122: No. 3, 467-478(15 Dec 1974).

A description is given of a special purpose hardware processor ZGE (Zero Guidance Electronics) designed for on-line data reduction by pattern recognition. This processor recognizes the patterns in the data coming from bubble chamber pictures scanned with a flying spot scanner HPD (Hough Powell Device). The processor is used as a beam track analyzer in a zero guidance measuring chain for a 7.3 GeV/c pp experiment. The design philosophy and hardware realisation is discussed, and first results from the measuring chain are given. (auth)

25908 THE PERFORMANCE OF A TOTAL ABSORPTION SPECTROMETER UP TO ENERGIES OF 60 GeV. Boehmer, V.; Engler, J.; Flauger, W.; Keim, H.; Moennig, F.; Pack, K.; Schopper, H. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik); Babaev, A.; Brackman, E.; Eliseev, G. Nucl. Instrum. Methods; 122: No. 3, 313-318(15 Dec 1974).

The response of a sampling total absorption counter (STAC) to protons, neutrons, pions, and electrons with incident energies up to 60 GeV is described. A good linearity was observed, and for protons a resolution of ±6% at 60 GeV/c could be achieved. The absolute fwhm rises slowly with energy from 4.5 GeV/c at 10 GeV/c to 7.2 GeV at 60 GeV/c. The fraction of the energy deposited in the scintillator by incident π^+ and e^+ is on the average 9% and 50% higher than that deposited by protons. (auth)

25909 METHODS OF CALCULATING SHOWER SPECTROMETERS. Stolyarova, E. L.; Samedov, V. V.; Novikov, E. S. pp 154-161 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

Expressions were derived for the pulse amplitudes and dispersion of the output signals of shower spectrometers. These formulas were used for the calculation of the energy resolution of KRS-6 monocrystals of different forms and dimensions and the results agreed with experimental data on the calibration these crystals in the electron energy region from 120 to 1200 MeV. (JSR)

Radiometric Instruments

25910 (UCRL-50025-75-1, pp 17-19) SURFACE TEMPERATURE CONTROL IN AN INDUCTION BRAZING FURNACE. Morrison, J. 1 Feb 1975.

In Electronics Engineering Department quarterly report.

The Rocky Flats Division of Dow Chemical Corporation was having difficulty making braze joints of specified strength on their production line. The braze joint between a monel and beryllium part was failing during a pull test. Investigation showed that a possible cause was a large variation in the brazing temperatures allowed under the existing temperature control system. By modifying commercially available hardware, we were able to reduce the temperature error from 50 to 100°C down to 1°C, thereby eliminating the failures. The system developed for this purpose is described. (auth)

25911 MASS DETERMINATION ON PLANTATIONS BY ABSORPTION OF GAMMA RADIATION. Kuehn, W.; Schaetzler, H. P. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Hanover (F.R. Germany). Inst. fuer Strahlenbotanik). Atomkernenergie; 24: No. 3, 209-212(1974).

From 5th annual meeting of the European Society of Nuclear Methods in Agriculture (Working Group: Radiation Analysis); Bucharest, Romania (19 Sep 1974). 5 figs.; 2 tabs.; 3 refs.

The total biomass as well as the local masses of a plantation

can be measured by continuous and discontinuous scanning of a narrow gamma-beam within a vertical plane. When using an Am 241 gamma-source the accuracy of the contactless mass determination of a cornfield is about 1 to 3% during the whole growing period, if field lengths up to 6 m are irradiated. The following report shows a scanning device running fully automatically which was constructed for plant breeders. Measurements with this prototype were carried out in the laboratory on a phantom of a cornfield consisting of plant equivalent material and of similar shape. The data are recorded by a multichannel analyzer working in multiscaling mode. The calculations are performed by data processing. (auth)

25912 EFFECT OF INTERFERING FACTORS ON SCATTERING AUREOLES IN PHOTONEUTRON PROSPECTING FOR BERYLLIUM DEPOSITS. Kramich, K. F.; Gorev, A. V. Ekspress-Inform., Ser.: Reg., Razved. Prom. Geofiz.; No. 1, 27-28 (1973). (In Russian).

The effect of density and moisture in rocks, and the presence of elements with large neutron capture cross-sections on the results of measurements in ground-level neutron prospecting for beryllium deposits with the beryllium meter, Berill-4, are discussed. (tr-auth)

25913 MEASUREMENT OF MOISTURE AND HYDROGEN CONTENTS BY INTERMEDIATE NEUTRON MODERATION. Wada, N. (Japan Atomic Energy Research Inst., Ibaraki). J. Radioanal. Chem.; 23: No. 1-2, 147-158(1974).

An intermediate neutron moderation method for measurement of moisture and/or hydrogen contents of small samples is presented. The sample is placed on the top face of a neutron howitzer, with a cadmium sheet between. Thermal neutrons resulting from intermediate neutron moderation in the sample are detected with a ^{3}He proportional counter placed on the sample, by a cadmium difference method. With a 500 mCi Am-Be neutron source, the limit of moisture detection for a $10 \times 20 \times 1.8$ cm^3 asbestos plate in 1 min count time is 0.5 wt %. The precision of measuring the hydrogen contents of 250 ml hydrocarbons containing 112 mg H/ml is 0.9% under the same conditions. (auth)

25914 METHOD AND APPARATUS FOR INVESTIGATING THE QUALITY OF WELL LOGGING DATA. Jacobson, L. A.; Wall, W. B.; Johnstone, C. W. (to Schlumberger Tech. Corp.). US Patent 3,868,505. 25 Feb 1975. Filed Date 31 Oct 1973. 16p.

Apparatus and methods are disclosed for investigating the quality of well logging data derived from a well tool of the type which repetitively irradiates an earth formation with pulses of neutrons, generates signals representative of the resulting neutron population in the formation between neutron pulses, derives a downhole measurement of a characteristic of the formation in response to the neutron population signals, and transmits to the earth's surface signals representative of the formation characteristic measurement and of the generated neutron population signals. A representation of the quality of the downhole formation characteristic measurement and of signal transmission to the surface is obtained, either at the well site or remotely, from the neutron population signals received at the surface. In the illustrative embodiments described, the downhole measurement of the formation characteristic is made by comparing the background-corrected counting rates from two measurement intervals between neutron pulses and adjusting the times of occurrence and durations of the intervals until the two counting rates are in a predetermined relationship to each other. A like comparison of counting rates is formed at the surface from the transmitted neutron population signals, and deviations of this surface comparison from the predetermined relationship established between the downhole counting rates affords information as to the quality of signal transmission to the surface and of the accuracy of the downhole formation characteristic measurement. If desired, a separate measurement of the formation characteristic may be made at the surface and the quality representation obtained by comparing the downhole measurement and the surface measurement. (Official Gazette)

25915 METHOD FOR SENSING PROFILE OF SHEET OR PLATE MATERIALS. Murata, Y.; Mashiko, Y.; Uchida, Y.; Matsumoto, M. (to Nippon Steel Corp.). US Patent 3,868,510. 25 Feb 1975. Priority Date 29 Dec 1971, Japan. 4p.

A method for sensing the profile of a sheet or plate material, in which the thickness of a sheet or plate material is measured by measuring the penetration damping amount of radiation (decrease of radiation due to penetration) within the sheet or plate material is described. A radiation generating part is made to scan the material in its crosswise direction while a radiation detector is fixed in place in such a manner as to extend for the entire width of the sheet or plate material corresponding to the radiation generating part, thus sensing the profile of the material. (Official Gazette)

25916 WELL LOGGING PROCESSING METHOD AND APPARATUS. Tittman, J. (to Schlumberger Tech. Corp.). US Patent 3,864,569. 4 Feb 1975. Filed Date 13 Apr 1973. 10p.

A specific embodiment of the invention identifies the chemical composition of an earth formation and compensates for mudcake during well logging. The formation is irradiated with photons that have energies less than about 1 MeV. A low energy gamma radiation detector is positioned close to the gamma radiation source primarily to measure borehole parameters, while a second low energy gamma radiation detector, spaced more distantly from the gamma ray source, measures borehole characteristics and the mineral composition of the formation. The signals from the detectors are normalized and combined to produce an output that identifies formation lithology and effective mudcake thickness. (Official Gazette)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 26466 and 28044.

25917 (AD-787029) PHYSICAL CUSTODIAN FOR DEVELOPMENT OF ROSCOE. A Radar and Optical Systems Code for Nuclear Effects. Volume I. The Zero-Order Radar Code for ROSCOE, Final Contract Report, 27 February 1973 – 27 February 1974, See Also Volume 2, AD-787030. Boys, J. A.; Ise, J.; Ford, L. R.; Garbarino, J. R.; Ostrowsky, H. S. (General Research Corp., Santa Barbara, Calif. (USA)). Mar 1974. 262p. (GRC-CR-1-384(Vol.1)). NTIS $8.50.

A description of a preliminary version of the radar and optical systems code for the evaluation of nuclear effects on sensors (zero-order ROSCOE) is presented. The code consists of a working radar system simulation with crude phenomenology. Descriptions of the following systems modules are presented: attack generation, object observables, track filter, radar logic (detection, track initiation, track, and discrimination), and radar signal processing. Propagation models for such effects as noise, attenuation, clutter, refraction, and multipath are also described. (auth)

25918 (AD-787292) TRANSIENT CURRENT INDUCED ON A CONDUCTING CYLINDER BY AN EMP PLANE WAVE WITH APPLICATIONS TO CABLE DRIVER DESIGN. Greene, H. W.; Holder, J. D.; Tsai, L. I. (Army Missile Command, Redstone Arsenal, Ala. (USA)). 16 Aug 1974. 63p. (RG-7508). NTIS $4.25.

The current excited on an infinite perfectly conducting cylinder by an incident electromagnetic pulse plane wave is analyzed using Fourier transform techniques. Two methods, Eigenfunction series solution and moment methods, are used independently to calculate the currents in the frequency domain. Time domain cylinder currents are found by inverse transforming the eigenfunction series results. These are computed at various aspects angles on the cylinder for three different cylinder sizes. The apparent rotational asymmetry and increase in rise time from the theoretical solution should be useful in improving cable driver design. A number of possible extensions of this problem are given together with an approach to correlate simulator and cable driver data. (auth)

25919 (AGC-NRO-1325) RADIATION EFFECTS ON NERVA INSTRUMENTATION. Gilles, W. P. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1968. 26p. Dep. NTIS $4.50.

The NERVA program presented the instrumentation engineer with difficult radiation effects problems. Gamma fluxes reach 10^9 rads(C)/hr and neutron fluences approach 10^{18} n/cm^2 (E > 1.0 MeV). These problems and some of their solutions and test results are presented. (auth)

25920 (FZK-184-6) NERVA COMPONENTS IRRADIATION PROGRAM. Volume VI. GTR Test 15. Burtnett, R. L.; Evans, J. W.; Stuart, L. P.; Walton, M. B. (General Dynamics/Fort Worth, Tex. (USA)). 19 Mar 1965. 140p. Dep. NTIS $10.00.

The twelfth in the series of GTR irradiation tests to determine the effects of reactor radiation on candidate NERVA engine components was concluded on December 20, 1964. The items include cables and connectors, strain gages, resistance temperature transducers, thermocouples, and pressure transducers. (DLC)

25921 (RN-TM-0419) NRO TECHNICAL MEMORANDUM: TRANSMISSION CABLE TEMPERATURE EFFECTS. Takeda, S.

(Aerojet-General Corp., Sacramento, Calif. (USA)). 27 Feb 1967. 19p. Dep. NTIS $4.00.

Among the effects of gamma flux on an instrumentation system is the change in transmission cable characteristics which is primarily due to the increase in temperature of the cable. It is the intent of this discussion to demonstrate this effect in terms of errors introduced into an instrumentation system by changes in sheathed cable resistance and cable isolation. The strain gage (full-bridge), potentiometric RTT (constant current), double bridge RTT, piezoelectric accelerometer using the charge amplifier, and thermocouple systems were investigated. It was assumed that in each system fifteen feet of sheathed cable were exposed to temperatures ranging from 1200 to 1800°R. These temperatures were then translated into changes in line resistance and shunt resistance. Introduction of these values into the various systems and analyses of these systems indicated that no general problems arose because of temperature except in the case of the strain gage system. The errors due to the temperature effects for this system are shown. (WHK)

25922 (TID/SNA-802) RADIATION EFFECTS TEST PROGRAM PLAN: INSTRUMENTATION, COMPONENTS, AND ELECTRONICS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1972. 17p. Dep. NTIS $4.00.

This document contains in tabular form a summary of radiation effect tests currently planned for NERVA instrumentation, components, and electronics. Both Westinghouse Astronuclear Laboratory and Aerojet Nuclear Systems Company planning is covered. In addition, LASL tests planned for GTR-23 are listed. The ANSC planning covers testing through CY 1972. The WANL planning covers testing through CY 1974. Deletions, additions, and changes are recapitulated in revisions to the document issued quarterly. This issue (January) is the second revision. Significant changes from the previous issue are indicated by footnotes. (auth)

25923 (TID/SNA-803) RADIATION EFFECTS TEST PROGRAM PLAN: INSTRUMENTATION, COMPONENTS, AND ELECTRONICS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1971. 17p. Dep. NTIS $4.00.

This document contains, in tabular form, a summary of radiation effect tests currently planned for NERVA instrumentation, components, and electronics. Both Westinghouse Astronuclear Laboratory and Aerojet Nuclear Systems Company planning is covered. The ANSC planning covers testing through CY 1972. The WANL planning covers testing through CY 1974. Deletions, additions, and changes are recapitulated in revisions to the document issued quarterly. This issue (October), is the first revision. Significant changes from the previous issue are indicated by footnotes. (auth)

25924 (WANL-TME-1062) SEVERAL W/W–26% IN-CORE THERMOCOUPLE DESIGNS TESTED IN A SIMULATED NRX-A3 ENVIRONMENT. Dunn, W. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Dec 1964. 23p. Dep. NTIS $4.25.

Declassified 13 Mar 1975.

A series of tests was performed in the WANL fuel element corrosion furnace on W/W–26% Re high temperature in-core thermocouples. The majority of these thermocouples were intended for use on the NRX-A3 reactor and were installed and tested in a central element in a simulated NRX environment. Results are presented and discussed, and it is recommended that the central element hole in which thermocouples are installed be enlarged from the present 0.100 inch diameter to at least a 0.110 inch diameter to allow a larger thermocouple diameter in the interest of more accurate in-core temperature measurements. (WHK)

25925 LOW–TEMPERATURE IRRADIATION EFFECTS IN SiO_2–INSULATED MIS DEVICES. Harari, E.; Wang, S.; Royce, B.S.H. (Materials Laboratory, Princeton University, Princeton, New Jersey 08540). J. Appl. Phys. 46: No. 3, 1310-1317 (Mar 1975).

The storage of positive charge in the SiO_2 insulator of MIS devices has been studied at both 300 and 80 K. It has been found that additional charge is stored in the oxide as a result of low–temperature x irradiation and behaves differently from that induced by room–temperature irradiation. This additional charge may be removed from the oxide by photodepopulation techniques, field emission, and thermal annealing. The portion of the charge which is present at both 300 and 80 K is shown to be insensitive to these treatments under the same experimental conditions. The experimental data indicate that the observed behavior is not due to positive ion transport within the oxide and strongly suggests that hole transport is occurring. Models for the trapping sites and the role of surface states are discussed. (auth)

Miscellaneous Instruments

Refer also to abstracts 25578, 25990, 28068, and 28806.

25926 (AE–489(Vol.1), pp 83-87) COMPUTER CONTROLLED X-RAY SPECTROPHOTOMETER. Jacobson, B.; Petersson, C. (Karolinska Inst., Stockholm). Dec 1974.

In bone mineral and determinations.

The x-ray spectrophotometer is designed for bone mineral and soft tissue determinations on adult humans. The equipment comprises an x-ray tube with a special high-voltage generator and a filtering unit to produce two narrow energy bands, a system composed of two servo-controlled measuring wedges with attenuation properties corresponding to bone mineral and soft tissues, respectively, a scintillator photomultiplier detector, a feedback loop coupled to the servo-controlled wedges, and a minicomputer. The wedges are automatically kept in such a position that the x-ray fluxes are constant at the scintillator. When the object is placed in the beam the wedges are automatically withdrawn, the displacements constituting a quantitative measure of the amounts of the analyzed substances in the transversed volume of the object. The system has a high degree of stability and precision. (auth)

25927 (CONF-730941-) PROCEEDINGS OF THE GRANTEES CONFERENCE ON INSTRUMENTATION TECHNOLOGY, WASHINGTON, DC, SEPTEMBER 25–26, 1973. (NEUS, Inc., Santa Monica, Calif. (USA)). 1973. 181p. NEUS, Inc., Santa Monica, CA.

Separate abstracts were prepared for 9 of the 16 papers presented. The remaining 7 papers were not within the scope of NSA. (WHK)

For abstracts of individual papers see: 25709, 25710, 25801, 26071–26075, and 26587.

25928 (NICP-7405) AURORAL PHOTOMETER WITH AUTOMATIC ZERO SUPPRESSION AMPLIFIER. Sten, T. A. (Norske Institutt for Kosmisk Fysikk, Oslo). Oct 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

The electronic design of an improved auroral rocket photometer is presented. A new amplifier design with ten or sixteen linear ranges, dependent on the selected mode of an up-down counter, is incorporated. The block diagram of the photometer is discussed and descriptions of the main components given. Wiring diagrams of the amplifier and calibration circuit and current limiter are also presented. (NO)

25929 (TID-SNA-399) EVALUATION TESTING OF ORGANIC INSULATED CABLES, TPr-t102-EWH001-152. Category I Test Procedure. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 31p. Dep. NTIS $4.75.

Test procedures to be used for the evaluation testing of flexible organic insulated cables selected as part of the development and qualification of NERVA Engine Wiring Harness, Project 152 are discussed. This Test Procedure forms a part of Test Plan t102-EWH001-152 and encompasses the testing activities to be performed in the Aerojet Nuclear Systems (ANSC) Laboratory and/or at an independent testing laboratory. (auth)

25930 (TID/SNA-401) EVALUATION TESTING OF ORGANIC INSULATED CABLES, TP-t102-EWH001-152. Category I Test Plan. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. Dep. NTIS $4.75.

The primary purpose of this test was to investigate the electrical and mechanical characteristics of the candidate cables in simulated NERVA environments. The data obtained from these tests will be used as baseline data for the cables being irradiated in GTR-22 as well as for cable design, installation and terminating criteria. The test requirements, data handling, and quality assurance requirements are specified. (WHK)

25931 (TID/SNA-587) EVALUATION TESTING OF ORGANIC INSULATED CABLES. Category 1 Test Plan. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 34p. Dep. NTIS $4.75.

This Test Plan encompasses the laboratory testing of candidate organic insulated flexible cables being evaluated in support of the development and qualification of the NERVA Engine Wiring Harness, Project 152. The use of polyimide insulated wires and cables in the engine area forward of the pressure vessel dome was selected by the results of the design study S054-TS422-W153-04d-2. The environment extremes above the forward closure appear to be within the capabilities of the organic insulation material, however, information on the environment effects on the electrical and mechanical properties is limited. The advantages of using flexible organic insulated cable are many. Harness weight is reduced; routing, installation and termination are simplified; and flexing problems in the gimbal plane area are minimized. The lack of a suitable organic insulated cable would necessitate the development of metal-sheathed cables and terminations resulting in complex inter- and intrafaces with the engine modules and stage disconnect. (auth)

25932 (TID/SNA-588) EVALUATION TESTING OF ORGANIC INSULATED CABLES. Category 1 Test Procedure. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 32p. Dep. NTIS $4.75.

This document delineates the test procedures to be used for the evaluation testing of flexible organic insulated cables selected as part of the development and qualification of NERVA Engine Wiring Harness, Project 152. This Test Procedure forms a part of Test Plan t102-EWH001-152 and encompasses the testing activities to be performed in the Aerojet Nuclear Systems (ANSC) Laboratory and/or at an independent testing laboratory. (auth)

25933 (UCRL-50025-75-1) ELECTRONICS ENGINEERING DEPARTMENT QUARTERLY REPORT. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1975. Contract W-7405-eng-48. 30p. Dep. NTIS $4.00.

A separate abstract was prepared for each of the eight sections included. (WHK)

For abstracts of individual sections see: 25374, 25375, 25910, and 25934–25938.

25934 (UCRL-50025-75-1, pp 1-4) FLOW CELL ANALYZER. Steinmetz, L. L. 1 Feb 1975.

In Electronics Engineering Department quarterly report.

An instrument that provides high-speed analysis and sorting of dispersed (micron-sized) cells of biological material is described. A laser is used to "see" the cells, which are then sorted electrostatically. Two simultaneous sortings can be made with high precision at the rate of approximately 1000 samples per second. A number of different cellular species have been analyzed and sorted since the instrument became operational in late 1973. (auth)

25935 (UCRL-50025-75-1, pp 7-12) DIGITAL IMAGE PROCESSING. Ekstrom, M. P. 1 Feb 1975.

In Electronics Engineering Department quarterly report.

This article describes a highly interactive digital image-processing and display system being developed in the Engineering Research Division. This system is interfaced to the OCTOPUS and is used for image enhancement applications in flash x-ray diagnostics, magnetic compression studies, nondestructive testing, and Linac diagnostics. It couples the mass on-line storage, hi-performance scientific computers, and hi-speed communication links of OCTOPUS with a digital picture display system to provide a flexible research tool for digital image processing. A supporting software system is being developed to allow the user to interact with the processing in a variety of ways. This system can perform sophisticated image-processing tasks at rates not previously attainable while supporting local interaction with the processed image. (auth)

25936 (UCRL-50025-75-1, pp 13-16) MOS/LSI CUSTOM DESIGN FACILITY. Ciarlo, D.; Alexander, E. 1 Feb 1975.

In Electronics Engineering Department quarterly report.

The Engineering Research Division has developed an in-house capability to design and fabricate large-scale integrated (LSI) circuits using a computer-aided design (CAD) system. The CAD system will generate the photomasks required for fabrication of the LSI circuits from a logic design submitted by a circuit designer. It also permits operator interaction for the purpose of correcting errors and optimizing the layout of the circuits. A p-channel metal-oxide-silicon (PMOS) LSI was successfully fabricated in our existing silicon processing facility. The present facility is capable of processing 1¼ in.-diam silicon wafers. A much improved facility capable of processing 2-in.-diam silicon wafers is scheduled for completion by mid-February 1975. (auth)

25937 (UCRL-50025-75-1, pp 23-24) NAD SYSTEM AS AN NTS DIAGNOSTIC TOOL. Alrick, K. 1 Feb 1975.

In Electronics Engineering Department quarterly report.

The Nevada Automated Diagnostic (NAD) System is an integrated digital data acquisition system used for sensing, recording, and processing data from nuclear tests. This article provides a brief description of the NAD system, highlights recent activities, and makes some projections for developments in the near future. (auth)

25938 (UCRL-50025-75-1, pp 25-28) HIGH-SPEED RADIATION CAMERAS. Coutts, G. W.; Olk, L. B.; Gates, H.; St. Leger-Barter, G. 1 Feb 1975.

In Electronics Engineering Department quarterly report.

Since the development of nanosecond pulse width radiation sources, there has been a continuing interest in obtaining some visualization of the space-time relationship of the radiation source output. Early high-speed radiation cameras used for this purpose employed fast scintillators and electronically shuttered image intensifier arrays. These early systems used a pinhole camera to produce a radiation image on the scintillator. Such systems, however, have a time resolution that is limited by the fluorescence lifetime of the scintillator and by the gating potential of the image intensifiers. To overcome these faults, we developed a framing camera system, based on absorptive phenomena and mode-locked lasers, that has picosecond resolution. This article describes the camera system. (auth)

25939 (UCRL-76036) STRAIN SENSITIVITY OF PRESSURE TRANSDUCERS IN A DYNAMIC ENVIRONMENT. Olsen, C. W.; Hatch, M. A. Jr.; Kalinowski, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.; EG and G, Inc., San Ramon, Calif. (USA)). [nd]. 21p. Dep. NTIS $4.25.

Strain error in pressure measurements is recognized as a trouble source, but seldom is it the major source of error in measurement. In experiments at the USERDA's Nevada Test Site, it has been necessary to obtain dynamic pressure data from inside pipes which are subject to an initial tensile stress of about one-half yield which changes rapidly to failure in a compressive mode. Static and dynamic data show that representative pressure transducers are subject to strain error and that the error is not only a function of stress in the mounting, but is also dependent on the rotational position of the transducer (about its own axis) as it is ported into the pipe. Schemes for decoupling the transducer from the pipe without seriously decreasing the burst capability of the installation have been investigated. A mounting using an annular cut-out around the transducer barrel has been devised which significantly decreases strain error and has little effect on the installation integrity or the response to dynamic gas pressure. (auth)

25940 A HIGH INTENSITY UV SOURCE FOR PHOTOELECTRON SPECTROSCOPY. Poole, R. T.; Liesegang, J.; Leckey, R. C. G.; Jenkin, J. G. (La Trobe Univ., Bundoora (Australia). Dept. of Physics). J. Electron Spectros. Relat. Phenomena; 4: No. 5, 773-782(Nov 1974).

From international conference on electron spectroscopy; Namur, Belgium (16 Apr 1974).

A source for the production of high intensity resonance radiation from inert gases has been developed in a form suitable for use with ultrahigh vacuum photoelectron spectrometers. A d.c. glow discharge (~100 mA) is maintained between water cooled aluminium electrodes via an uncooled quartz capillary of 1.5 mm diameter. A separate 0.5 mm diameter Pyrex capillary leads from the discharge region to the spectrometer with one stage of differential pumping being provided using a liquid nitrogen trapped oil diffusion pump. Capillary dimensions are such that the calculated gas flow reaching the spectrometer region is minimal (10 1/sec. in the case of Helium, if the spectrometer pressure is $\sim 10^{-10}$ torr). The source is readily demountable for electrode cleaning and is mechanically robust and self-aligning. When used with helium, useful intensity at 21.21, 23.09, 40.81 and 48.37 eV is produced, the relative intensities being functions of discharge current and gas pressure. When optimized for the production of 40.81 eV radiation the intensity at this photon energy is 170% of the intensity produced at 21.21 eV. Design and constructional details of the source are presented and the operational characteristics displayed by means of graphs showing the functional dependence of various line intensities on discharge current and pressure. (auth)

25941 A HELIUM 30.4 nm PHOTON SOURCE FOR PHOTOELECTRON SPECTROSCOPY. Burger, F.; Maier, J. P. (Basel Univ. (Switzerland)). J. Electron Spectros. Relat. Phenomena; 4: No. 5, 783-789(Nov 1974).

From international conference on electron spectroscopy; Namur, Belgium (16 Apr 1974).

A new type of photon source of helium 30.4 nm (HeII) radiation is described. The cold cathode discharge is operated at pressure $\sim 10^{-4}$-torr of helium by means of a charged particle oscillator arrangement which enhances the helium ion 30.4 nm emission. Sufficient photon flux is available with a discharge current of a few milliamps to record the HeII spectra on a X-Y plotter. The flux of the He 30.4 nm radiation is found to be superior to the He 58.4 nm output. (auth)

25942 MONOCHROMATIZATION OF SYNCHROTRON-RADIATION; PROSPECTS AND LIMITATIONS FOR ESCA EXPERIMENTS. Thimm, K. (Bonn Univ. (F.R. Germany). Physikalisches Inst.). J. Electron Spectros. Relat. Phenomena; 4: No. 5, 755-771(Nov 1974).

From international conference on electron spectroscopy; Namur, Belgium (16 Apr 1974).

At present the use of synchrotron radiation for photoelectron spectroscopy follows two lines: low resolution work, largely with solids, and high resolution work with gases which is in preparation. For the latter, grazing incidence concave grating monochromators

are required that can provide both high transmission and high resolution in the wavelength range from 10 to 600 Å. Unfortunately, the inherent properties of these monochromators are not particularly suited to the requirements of ESCA investigations and compromises must be made as to the transmission and the resolution obtainable. Both are highly wavelength dependent, the resolutions that can be expected with a 5 to 10 μ-slit being in the range of 10^3 to 2×10^4 for the wavelength range considered here. For the transmission of synchrotron radiation through the focusing system and the monochromator, only crude estimates can be made. This is due to the uncertainties about the efficiency of the imaging of the source into the entrance slit and the efficiency of the reflection and the diffraction at the grating. In favourable cases, a transmission of 1-5% could be obtained. (auth)

25943 NEW DEVELOPMENTS IN ESCA-INSTRUMENTATION. Fellner-Feldegg, H.; Gelius, U.; Wannberg, B.; Nilsson, A. G.; Basilier, E.; Siegbahn, K. (Uppsala Univ. (Sweden). Fysiska Institutionen). J. Electron Spectros. Relat. Phenomena; 4: No. 5, 643-689(Nov 1974).

From international conference on electron spectroscopy; Namur, Belgium (16 Apr 1974).

The different components of an ESCA-system are analyzed theoretically and conditions of optimum performance are used as basis for the design of different newly developed instruments. (auth)

25944 COMBINED ESCA/AUGER SYSTEM BASED ON THE DOUBLE PASS CYLINDRICAL MIRROR ANALYZER. Palmberg, P. W. (Physical Electronics Industries, Inc., Edina, Minn. (USA)). J. Electron Spectros. Relat. Phenomena; 4: No. 5, 691-703(Nov 1974).

From international conference on electron spectroscopy; Namur, Belgium (16 Apr 1974).

A double-pass cylindrical mirror analyzer with retarding grids is described, which functions with high sensitivity as an Auger spectrometer and also has adequate luminosity for ESCA applications. In addition to the obvious advantage of allowing ESCA and AES measurements with the same analyzer, this system has several other unique features such as selected area analysis, sample flexibility and simultaneous sputter etching. (auth)

25945 A STEP TOWARDS QUANTITATIVE ELECTRON SPECTROSCOPY MEASUREMENTS BY IMPROVED ELECTRON OPTICS. Noeller, H. G.; Polaschegg, H. D.; Schillalies, H. (Leybold-Heraeus G.m.b.H. und Co. K. G., Koeln (F.R. Germany)). J. Electron Spectros. Relat. Phenomena; 4: No. 5, 705-723(Nov 1974).

From international conference on electron spectroscopy; Namur, Belgium (16 Apr 1974).

The electron spectroscopy usually operates with a preretardation of electrons in order to improve the resolution of spherical condensers. Hereby generally important parameters are changed which influences the measurements with regard to intensity, resolution and comparability of the spectra. A retardation system with 4 degrees of freedom avoids these disadvantages because the magnification and the aperture are kept constant. This makes a quantitative mode of operation possible. In that way also the signal-to-noise ratio of the spectra can be improved. In addition the space requirement in the vicinity of the specimen is low and the specimen is free from electrical fields. The result is that the analyzer can be used for a multitude of applications. (auth)

25946 INSTRUMENTATION FOR SURFACE STUDIES; XPS ANGULAR DISTRIBUTIONS. Fadley, C. S. (Hawaii Univ., Honolulu (USA)). J. Electron Spectros. Relat. Phenomena; 4: No. 5, 725-754(Nov 1974).

From international conference on electron spectroscopy; Namur, Belgium (16 Apr 1974).

The application of XPS angular distribution measurements to surface studies is discussed. The basic principles behind the measurement and interpretation of such angular distributions from solid surfaces are presented, including a review of available experimental data. Effects of electron diffraction (channeling) are neglected, and a macroscopic model including the effects of x-ray refraction and reflection, a non-uniform x-ray flux, a non-constant spectrometer acceptance solid angle, non-uniform surface layer thicknesses, and surface roughness is discussed. The predictions of this model are found to be consistent in several respects with experimental data. The measurement of electron attenuation lengths, surface layer thicknesses, fractional surface layer coverages, and surface roughness characteristics thus all seem feasible from detailed analyses of such angular distributions. (auth)

25947 RADIOACTIVE DECAY CHAINS: AN ELECTRONIC ANALOGUE. Evans, G. R. (North Staffordshire Polytechnic, Eng.). Phys. Educ.; 9: No. 7, 487-498(Nov 1974).

The design and construction of an analogue computer is described which will solve the simultaneous differential equations governing the growth and decay of the nuclides in a simple, three member, radioactive decay chain. The instrument was constructed to provide a useful demonstration for teaching. It also provides a simple example of an analogue computer capable of solving problems of practical interest, and thus gives a useful introduction to analogue computer techniques. (UK)

25948 SINGLE PHOTOELECTRON TIME SPREAD MEASUREMENT OF FAST PHOTOMULTIPLIERS. Leskovar, B.; Lo, C. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Instrum. Methods; 123: No. 1, 145-160(1 Jan 1975).

Time spread measurements, using single photoelectrons of fast photomultipliers having dynodes with cesium-activated gallium-phosphide secondary emitting surfaces have been investigated. Measurements of the time spread, made by means of a specially developed measuring system with improved time resolution capabilities, on several 8850s and C31024s are presented and discussed. Critical evaluation of the measuring system is given, particularly concerning the influences of the light pulse width and the constant fraction discriminator timing errors on the system time-resolution capabilities. The measuring system incorporated a subnanosecond light-pulse generator capable of operating at a repetition rate of 3 MHz with output light pulses having a full width at half-maximum of less than 200 ps. It also incorporates a constant fraction discriminator which has a time walk less than ±35 ps over a range of input-pulse amplitudes from 35 mV to 8 V. The optimum operating conditions of the photomultipliers have been determined for minimum time spread and relative collection efficiency. The error of the time spread measurements, because of the finite width of the light pulse, is discussed and determined for different pulse widths. (auth)

25949 FAST-ELECTRON RECORDER BASED ON MEASUREMENT OF THE RATIO BETWEEN TWO LIGHT FLUXES. Leont'ev, K. L.; Khor'kov, N. A.; Rambidi, N. G. (Inst. of High Temperatures, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1090-1092(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 128-130(1974).

A device is described for recording fast electrons which are scattered by a gas target; the unit is based on measuring the brightness distribution of a diffraction-pattern image on a fluorescent screen by means of a photoelectron multiplier (p.e.m.). The instrument uses a two-channel circuit which allows measurement of the ratio between two light fluxes at an arbitrary point and the standard point. The measurement error is approximately 0.5% for a speed of response of approximately 0.8 sec. (auth)

25950 BALANCED FILTER USAGE IN RADIOISOTOPE X-RAY FLUORESCENCE BOREHOLE LOGGING. Meier, V. A.; Filuppov, M. M. Vestn. Leningrad. Univ., Geol., Geogr.; 18: No. 3, 133-136(Sep 1974). (In Russian).

Scintillation probes with balanced filters for radioisotope x-ray fluorescence borehole logging are discussed. The structure and the principle of operation of probes with one photomultiplier, on the photocathode of which two detectors are mounted, are considered in detail. Characteristics of two probes of this type, one of which having phosphorus with different decay times and the other having different detector light outputs are given. (auth)

25951 SOFTWARE STANDARDS AND CAMAC. Zobrist, D. W.; Fassbender, P.; Bearden, F. E.; Costrell, L. Instrum. Technol.; 22: No. 3, 33-38(Mar 1975).

One month prior to a meeting of the International Purdue Workshop on Industrial Computer Systems, the idea was conceived to demonstrate software transportability, using ANSI X3.9-1966 Standard FORTRAN and ISA-S61.1 external procedures for process control, and the demonstration was to point out the need and potential of standards in other areas. Two complete computer systems, including peripherals and CAMAC interfaces, and process instrumentation, were borrowed from a dozen scattered sources. The systems were hooked up and running in about two days. This article describes the demonstration project, the many obstacles encountered, and lessons learned. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 26478 and 26594.

25952 (CEA-CONF-2883) RECENT RESULTS ON LASER INDUCED CHEMICAL EFFECTS. Agostini, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1973. 10p. (CONF-740416-2). Dep. NTIS (US Sales Only) $4.00.

From second European electro-optics conference; Montreux, Switzerland (2 Apr 1974).

Three fields of laser-induced chemical effects are discussed. These include selective photocatalysis; selective two step photodissociation - highly selective chemical reaction; and multiphoton-induced chemical reactions - multiphoton dissociation of H_2. (TFD)

25953 (CSIR-SR-FIS-39) MAGNETIC ION SOURCE OF THE PRETORIA ELECTROMAGNETIC ISOTOPE SEPARATOR: A REPORT ON ITS CONSTRUCTION AND USE. Gries, W. H. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Physical Research Lab.). Feb 1973. 43p. INIS.

A design by Nielsen for solid substances was systematically investigated by Almén and Nielsen and forms the basis of the Pretoria design which is described in this report. The constructional details of the Pretoria design are described. These embrace the complete system, and what can be done with it. In addition there are data on the temperature profile in the ion source, and on the mass spectrum under "clean" conditions of operation. Illustrative examples of successful isotope separations in which this ion source system was used are also cited. (INIS)

25954 (KFK-2004) FLOW MEASUREMENTS IN A TWO STAGE SEPARATION NOZZLE USING FREE MOLECULAR PRESSURE PROBES. Ehrfeld, W.; Schmid, E. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). Dec 1974. 40p. (In German). Dep. NTIS (US Sales Only) $5.00.

Measurements of flow and demixing phenomena using free molecular pressure probes have been made in a separation nozzle system where the kinetic energy of the heavy fraction of a first nozzle is used to continue separation in a second nozzle connected directly to the first (double deflection system). Measurements carried out on He/SF_6-mixtures show that there is a much stronger separation of the mixture in the downstream nozzle under condition of increased inlet pressure or decrease in the cut of the first nozzle, since due to the higher gas flow friction effects are reduced and, hence, higher speed ratios can be attained. If the flow in the downstream nozzle is ducted on both sides by stationary walls, the flow resistance of the downstream nozzle causes a marked accumulation of flow in front of the skimmer of the first nozzle. However, if the second nozzle is designed as a convergent nozzle, i.e. without an inner nozzle duct, speed ratios higher by about 20% are found at the inlet of the second nozzle due to the lower flow resistance. The reduced effect upon the upstream nozzle and the improved suction condition in the convergent nozzle could become important, especially if the radius of curvature of the second nozzle is considerably decreased relative to that of the upstream nozzle. (auth)

25955 (ORO-3913-6) ISOTOPE SEPARATION BY PARAMETRIC PUMPING AND HEATLESS ADSORPTION. Final Report. Hamrin, C. E. Jr. (Kentucky Univ., Lexington (USA). Dept. of Chemical Engineering). Sep 1973. Contract AT(40-1)-3913. 174p. Dep. NTIS $11.75.

Separation of boron isotopes by parametric pumping was accomplished using a boron trifluoride-dimethyl sulfoxide system. Hydrogen isotopes were separated continuously in an H_2-D_2 gas mixture using palladium by a cyclic process called heatless adsorption. Enzyme separation was also demonstrated to occur in a pH parametric pump. In each case the separations were less than predicted by simple equilibrium theory for the processes; however the theory does allow evaluation of potential isotope separations based on single-stage separation factors. (auth)

25956 (SAND-75-0121) GAS DYNAMIC PROBLEMS IN ISOTOPE SEPARATION. Touryan, K. J.; Muntz, E. P.; Talbot, L.; Von Halle, E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 83p. Dep. NTIS $7.25.

A synopsis is given of the presentations and discussions held at a workshop on the gas dynamic problems inherent in aerodynamic isotope separation devices. Five principal aerodynamic devices are considered in some detail. These are: (1) the curved separation nozzle; (2) the opposite jet scheme; (3) the separation probe scheme; (4) the jet membrane device, and (5) the crossed-beam device. (auth)

25957 THE ENRICHMENT OF URANIUM: INDUSTRIAL FACTS TODAY. Pecqueur, M.; Coates, J. H.; Mezin, M. (CEA, 75 - Paris (France)). Kerntechnik; 16: No. 11, 475-480(Nov 1974).

11 figs.; 1 tab.

Today, nuclear energy has reached an industrial stage and growing uranium enrichments are foreseen. But the existing or planned enrichment capacity will be insufficient to cover the needs in the early 1980s. Two processes can be considered, namely the time-proven gaseous diffusion and the newcoming ultracentrifuge. In view of present contracting conditions and of the various enrichment sources available, it was felt that a large and reliable plant should be constructed in Europe. The extensive experience in gaseous diffusion gained by the C.E.A. in the construction and operation of Pierelatte has been broadened by a thorough experimental program which led first to the Eurodif Study Group, then to the construction of the Tricastin Plant. (auth)

25958 THE SEPARATION OF URANIUM ISOTOPES IN GAS CENTRIFUGES IN THE PRESENCE OF LIGHT GAS COMPONENTS. Fuhse, W. A. Atomkernenergie; 24: No. 3, 161-170 (1974).

16 figs.; 12 refs.

The principles of the separation of uranium isotopes in the presence of light gas are evaluated and the basic equations governing the flows and diffusion processes indicated. With regard to gas centrifuges those solutions for the set of equations are found which are characterized by stable axial flows and a thermodynamical equilibrium of light and heavy particles. It is shown that the light gas components can in fact increase the separative power of gas centrifuges. The consideration includes the separation of isotopes in a pure atmosphere of uranium compounds and the agreement with previous theories is shown. (auth)

25959 LASER ISOTOPE SEPARATION USING TWO-PHOTON SELECTIVE EXCITATION: ITS QUANTUM EFFICIENCY AND SEPARATION FACTOR. Liu, Y. S. (General Electric Co., Schenectady, NY). Appl. Opt.; 13: No. 11, 2505-2511(Nov 1974).

Application of two-photon selective excitation to isotope separation with high power, high resolution tunable lasers is discussed. A simple kinetic model is given to determine quantum efficiency and separation factor in terms of laser powers and relaxation constants. A numerical example is used to demonstrate the feasibility of the scheme. Results indicate that a high quantum yield is obtainable with the optical technique. (auth)

25960 LINE-WIDTH AND TUNING EFFECTS IN RESONANT EXCITATION. Greenstein, H. (Stanford Univ., CA). J. Opt. Soc. Amer.; 65: No. 1, 33-40(Jan 1975).

Effects deriving from the finite spectral line width of an irradiation source are investigated for the resonant excitation process and found to be of particular interest when the irradiation spectral width is comparable with atomic (or molecular) line widths. An application of high current interest is laser isotope separation using relatively broad band but tunable dye lasers for selective excitation. Expressions are derived in systematic fashion for the absorption coefficient and for the yield, taking into account three independent line shapes - the first describing the irradiation source, the other two describing Lorentz and Doppler broadening of the atomic (or molecular) medium. Saturation effects are included, but propagation effects are neglected. It is shown that the customary distinction between homogeneous and inhomogeneous atomic-line broadening must be modified if the irradiation is not monochromatic. A further result of practical importance is that there exists an optimum irradiation line width that maximizes the yield for resonant transfer. In this respect, the relatively broad spectral widths characteristic of dye lasers are to be regarded as an advantageous feature, contrary to what is generally assumed. (auth)

25961 HEAVY WATER PLANTS: DOUBLING UNDER WAY, THIRD PLANT PLANNED. Mod. Power Eng.; 68: No. 12, 52-53 (Dec 1974).

The Bruce A heavy water plant is now operating, and another unit, Bruce B is under construction. A third plant of equal size, Bruce C, is in the planning stage. Sulzer columns will be used instead of trays in the third or finishing stage of the Bruce B and C designs. Special features of the Sulzer units are their lower hold-up, lower steam consumption, and energy conservation since there is a lower pressure drop across them. (CA)

25962 URANIUM ENRICHMENT. Nucleonics Week Special Report. New York; McGraw-Hill, Inc. (1974). 60p.

A collection of newsworthy items on uranium enrichment that appeared in Nucleonics Week during 1974 is presented. (TFD)

Isotopic Power Sources

Refer also to abstracts 25488 and 25489.

25963 (AEC/SNS-3063-6) COMPRESSIBLE FLOW THROUGH A TUBE CONNECTING A CONTINUUM AND A VACUUM. Schock, A. (Fairchild Space and Electronics Co., Germantown, Md. (USA)). 5 Aug 1974. Contract AT(49-15)-3063. 46p. Dep. NTIS $5.50.

Certain fluid flow applications require the analysis of flow through a long tube whose upstream end operates in the continuum regime and whose downstream end is in the molecular-flow regime. For example, in radioisotope power sources used in space vehicles, prevention of excessive pressure build-up in the heat source usually requires that the helium generated by alpha decay be vented to space vacuum. In doing so, it is generally desirable that the vent tube have a very low conductance, so as to maintain a reasonably high helium pressure (e.g., several psi) in the heat source. This promotes heat transfer across internal gaps, which is beneficial because it reduces the fuel operating temperature. Maintenance of such upstream pressures in spite of the very low helium flow rates (typically less than 1 g/y) may require vent tubes with extremely high length-to-diameter ratios. Over the length of these tubes, the flow changes from continuum to free-molecular. Numerous solutions for compressible continuum flow and for molecular or Knudsen flow have been published, although the latter are often of limited validity, because they are derived from a momentum balance which omits the acceleration term resulting from fluid expansion. It is this term which leads to the Mach number limit for flow leaving the tube. As shown, that limit can apply not only to continuum flow, as generally recognized in compressible flow solutions, but also to Knudsen flow. The purpose of this paper, then, is to derive a general solution for flow in the continuum, Knudsen, and transition regimes, taking proper account of the Mach number limit in all regimes. (auth)

25964 (HIT-429) VENTING HELIUM FROM ENCAPSULATED ALPHA-EMITTING RADIOISOTOPE HEAT SOURCES. Quarterly Progress Report No. 10. (Hittman Associates, Inc., Columbia, Md. (USA)). Jan 1970. 50p. Dep. NTIS $5.50.

Declassified 2 Nov 1971. For Mound Lab., Miamisburg, O.

The overall objectives of the Phase III Helium Vent Program are to further develop, life test, characterize, and prequalify prototype selective vent devices. The major program emphasis is being placed on the high temperature platinum-zircon mullite vent devices. During this quarter the major emphasis has been placed on life testing, fabrication of larger vents, and vent characterization testing. (LCL)

25965 (LA-5855-MS) SAFETY TEST NO. S-6, LAUNCH PAD ABORT SEQUENTIAL TEST PHASE III: FSA IMPACTS. Snow, E. C.; Frantz, C. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 17p. Dep. NTIS $4.00.

Five fuel sphere assembly (FSA) impact tests have been conducted in the LASL gas gun facility as part of the MHW/LES 8-9 Launch Abort Test. Three of these were done at low or launch pad fall-back velocities of approximately 30 m/s (100 fps), one was a single sphere impact on sharp steel and the other two were double sphere impacts on flat concrete at different temperatures. Two tests were also conducted at reentry velocities and temperatures, using targets of flat concrete and compact soil. The post impact containment shell (PICS) deformation resulting from these five impacts ranged from nearly zero in the case of the compact soil target to a hoop strain deformation of 7% in the case of the reentry velocity impact on concrete. However, the only PICS failure occurred in the low velocity double sphere impact on concrete, in which the PICS temperature was approximately 500°C. The operation of each of these five tests, along with the test results and posttest analyses, is described in detail. Several important conclusions are also drawn from these results and analyses. (auth)

25966 (N-74-28629) G-189A ANALYTICAL SIMULATION OF THE INTEGRATED WASTE MANAGEMENT-WATER SYSTEM USING RADIOISOTOPES FOR THERMAL ENERGY. Coggi, J. V.; Loscutoff, A. V.; Barker, R. S. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). Nov 1973. Contract NAS8-28982. 256p. (NASA-CR-120251; MDC-G-4901). NTIS $16.00.

An analytical simulation of the RITE-Integrated Waste Management and Water Recovery System using radioisotopes for thermal energy was prepared for the NASA-Manned Space Flight Center (MSFC). The RITE system is the most advanced concept water-waste management system currently under development and has undergone extended duration testing. It has the capability of disposing of nearly all spacecraft wastes including feces and trash and of recovering water from usual waste water sources: urine, condensate, wash water, etc. All of the process heat normally used in the system is produced from low penalty radioisotope heat sources. The analytical simulation was developed with the G189A computer program. The objective of the simulation was to obtain an analytical simulation which can be used to (1) evaluate the current RITE system steady state and transient performance during normal operating conditions, and also during off normal operating conditions including failure modes; and (2) evaluate the effects of variations in component design parameters and vehicle interface parameters on system performance. (auth)

25967 (SC-RR-64-1798) PREFLIGHT PREDICTIONS FOR THE REENTRY BURNUP OF RFD-2 FUEL CAPSULES. Cropp, L. O. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1965. 27p. Dep. NTIS $4.50.

Declassified 4 Mar 1975.

The Sandia Corporation Reentry Flight Demonstration Number 2 (RFD-2) contains an external set of simulated SNAP isotopic fuel capsules which will be exposed to reentry heating at a predetermined altitude to determine if these fuel capsules will actually ablate during reentry. When the walls of these capsules are ablated, tracer materials will be exposed which ablate with characteristic emissions that are identifiable by spectrographic methods. This analysis has been performed to facilitate camera tracking of the capsules during tracer exposure and to provide a theoretical approach for analysis of the experimental data. Four external capsule configurations are to be simulated on RFD-2. All contain cylindrical spectrographic tracers surrounded by an annulus of insulating material and an outer metallic cover. In three of the configurations, the outer cover consists of Haynes metal with an outside diameter of 0.840 in. and a thickness of 0.05 in., and a tantalum inner liner 0.006-, 0.012-, and 0.020-in. thick, respectively. In the fourth, the cover consists only of Haynes metal of the same size as the other configurations. Two thermal models for computer simulations were used in this analysis. Within the framework and limitations of this analysis, it is predicted that all of the RFD-2 fuel capsules will be ablated and expose their tracer materials at the designated altitudes. (TFD)

25968 (SC-RR-65-78) RE-ENTRY ABLATION OF A STRONTIUM FUEL FORM. Cropp, L. O.; Horton, R. N. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1965. 45p. Dep. NTIS $5.25.

Declassified 4 Mar 1975.

This study was performed in partial response to questions posed by the Atomic Energy Commission concerning the ablation and dispersal of strontium fluoride during reentry heating. Current safety philosophies for most aerospace isotope systems seem to require that, upon random reentry into the earth's atmosphere, the fuel be dispersed as particles 1 micron or less in dia at altitudes above 100,000 ft. The above criteria will be assumed to be adequate for strontium fluoride. An analysis of a strontium-fluoride-fueled system was performed in a way which would tend to satisfy these requirements within all reasonable limits. The generator system was assumed to re-enter from an operational orbit with the fuel capsules released at an optimum altitude for burnup. The following conclusions were drawn from the analysis: (1) any reentry of strontium fluoride in the two configurations studied will result in a high probability of incomplete fusion of the strontium fluoride; (2) of the fused strontium fluoride, less than 30% of the mass will be vaporized, with the remainder falling to earth as large particles; and (3) for these reasons, strontium fluoride does not appear to satisfy the current safety philosophy requiring submicron particles dispersed at altitudes above 100,000 ft. (TFD)

25969 A METHOD FOR PREPARING PLUTONIUM DIOXIDE OF BIOMEDICAL GRADE. Leary, J. A.; Nance, R. L.; Mullins, L. J. (to USAEC, Washington, D. C.). French Patent 2178140/A/. 28 Mar 1973. 7p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France). Priority claim: 28 Mar 1972, USA.

The procedure is characterized by the powdering of electrically refined massive ^{238}Pu by successive cycles of hydridation and dehydridation. The powdered ^{238}Pu largely but not completely dehydrided reacts then with gaseous H_2 ^{16}O in a helium current at a temperature of 580 to 610°C. The oxide thus produced is then heated to 700°C under vacuum for a short time in order to elimi-

nate the volatile impurities. Such a procedure is particularly convenient for preparing a heat source for an artificial heart or a heart pacer. (tr-FR)

Radiation Sources

25970 (CONF-750216-1) NEUTRON SOURCE FOR RADIOGRAPHY AND GAUGING. Cutforth, D. C. (Argonne National Lab., Ill. (USA)). 1975. 30p. Dep. NTIS $4.50.

From symposium on practical applications of neutron radiography and gauging; Gaithersburg, Maryland, USA (10 Feb 1975).

A review of technical and economic characteristics of various types of neutron sources that could be considered for neutron radiography and gauging is presented. Minimum application requirements along with sources that may be used to satisfy the requirements are presented. The primary organizations in the United States that offer commercial neutron radiography services are listed. Contacts at some organizations that manufacture and/or distribute neutron sources are also included. (auth)

25971 DENSIFICATION OF IRRADIATED METAL. France, D. W.; Ketcham, A. A. (to General Electric Co.). Canadian Patent 960,377. 31 Dec 1974.

The process described starts with particles of the metal in an unirradiated condition (target metal) and encapsulates the particles of target metal in a metallic jacket in a cross section promoting the absorption of neutrons throughout the target metal. During the remainder of the process, the target metal is enclosed in shielded zones to confine radioactive energy release. Next, the encapsulated target metal is subjected to irradiation sufficient to enable the atoms of the metal to capture neutrons and the irradiated metal is removed from the aluminum encapsulation. A given weight of the irradiated metal sufficient to provide a known irradiation output is measured and the irradiated metal is subjected to sufficient energy to be liquified and then solidified in a desired shape. The irradiated metal thus treated is ready to be positioned in a source holder. (auth)

25972 RADIATION CIRCUIT HYDRAULIC SYSTEM FOR NUCLEAR REACTORS AND THE LIKE. Gavar, V. V.; Dindun, A. S.; Kramer, M. M.; Platatsis, E. Y.; Mikelson, A. E.; Tomson, E. Y. US Patent 3,860,825. 14 Jan 1975. Filed Date 2 Mar 1973. 4p.

A radiation circuit including a hydraulic system and comprising an activity generator, an irradiator, a tank for storing an activity carrier and a pump for the circulation of the activity carrier in the circuit, all interconnected by pipelines is described. The circuit is provided with a mixing chamber and an additional pump, the upper section of the mixing chamber communicating with the outlets of the activity generator and irradiator, and its lower section, through the pumps, with the inlets of the activity generator and irradiator. The chamber is arranged in a manner in which its upper section is below the lower portions of the activity generator and irradiator. (Official Gazette)

25973 THE USE OF A DENSE PLASMA FOCUS ACCELERATOR IN NUCLEAR PHYSICS. Bar Avraham, E.; Porath, Y. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Nucl. Instrum. Methods; 123: No. 1, 5-9(1 Jan 1975).

The properties and the operation of a dense plasma focus accelerator are briefly described in connection with its possible use in nuclear physics. An example of the half-life measurement of ^{24}Na with the accelerator is given. (auth)

25974 SEALED RADIOACTIVE SOURCES. Requirements and Classification. Draft. pp DIN 25426 B1.1 of German norms. Berlin, F. R. Germany; Beuth (Sep 1974). (In German).

The object of this draft is to give the manufacturers, deliverers, users and the appropriate authorities universal criteria as to the judging of the safety when dealing with sealed radioactive materials. For this purpose, the physical-chemical state as well as the thermal and mechanical capacity to withstand stresses of the sealed radioactive materials are classified. (auth)

Design and Fabrication

25975 (ANL-CT-74-45824-0010) NEUTRON SOURCE BARREL FACILITY. Yingling, G. E.; Taboas, A. L.; Zayas, F. G. (Argonne National Lab., Ill. (USA)). 1 Dec 1974. Contract W-31-109-eng-38. 20p. AT.

A new neutron source barrel facility was recently assembled and calibrated. The epoxy resin and graphite moderators used are contained in a 30 gal steel drum. Two aluminum tubes are imbedded in the moderator parallel to the barrel vertical axis. The tubes are used to hold a neutron source and a detector and are 2 and $4^{1}/_{16}$ inches inside diameter, respectfully. Two 7 Ci Pu-Be neutron sources are available and either one or both sources can be placed in a Lucite source holder. The relative placement of the neutron source and detector sensitive lengths can be adjusted through the use of Lucite spacers. For convenience, the source barrel was placed on a dolly with rubber wheels. Design, construction details, and calibration of the barrel facility are presented. (TFD)

25976 EFFECT OF THE CONSTRUCTION AND PREPARATION TECHNOLOGY OF ISOTOPIC (α,n) SOURCES ON THE FORM OF THE NEUTRON SPECTRUM. Tyufyakov, N. D.; Kozlov, A. G.; Pavlovich, V. B.; Trykov, L. A.; Shtan, A. S. pp 73-76 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

Experiments have shown that the neutron spectra of (α,n) sources are not affected by the method of preparation. However, as the energy of the neutrons in these sources depends on the angle of flight of the neutron relative to the direction of motion of the α particle, it can be assumed that the neutron spectra would depend on the construction if there were a preferred direction of motion of the α particles to the source. In sources with stratified active zones a dependence of the neutron spectra on the angle to the preferred motion of α particles is shown for (^{238}Pu + Be) sources. The form of the neutron spectra of sources with stratified active zones strongly depends on the point of measurement and is significantly different from sources with a homogeneous active zone. (JSR)

25977 SPUTTERING INSTALLATION FOR PREPARATION OF LARGE AREA SPECTROMETRIC SOURCES. Yakunin, M. I. pp 149-153 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

A chamber making it possible to obtain intense cathode sputtering of different materials on large-area supports up to 0.3 m^3 is described. It is designed for the preparation of α spectrometric sources from materials of very low specific activity. (JSR)

25978 A METHOD AND DEVICE FOR FORMING CHARGED PARTICLES CURTAINS. Denholm, A. S.; Simcox, G. K. (to Energy Sciences, Inc., Burlington, Mass. (USA)). French Patent 2177793/A/. 7 Mar 1973. Priority date 24 Mar 1972, USA. 15p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A pulse irradiation device is described in which the charged particles are accelerated by high voltages, without breakdown to the interior of the generator, because of the excitation of the generator by pulses having very similar rise and fall times. The pulses are formed by a half-cycle of a resonance current. (tr-FR)

25979 REMOTELY CONTROLLED BRACHYTHERAPY UNIT. Whitfield, D. (to Atomic Energy of Canada Ltd.). US Patent 3,866,050. 11 Feb 1975. Priority Date 15 May 1972, Canada. 6p.

A method and apparatus is provided whereby a point or elongate radioactive source is introduced into the body of a patient and a source is subsequently oscillated whereby the spacial distribution of radioactivity can be varied to give spherical, oblate spheroidal or cigar-shaped configuration. The invention further contemplates arcuate oscillation in addition to linear oscillation. (Official Gazette)

Industrial Uses

Refer also to abstracts 25278–25280, 25282–25287, and 25733.

25980 (AAEC/E-330) EVALUATION OF THE USE OF GAMMA RADIATION IN SEWAGE TREATMENT. Bonhote, P. A.; Clouston, J. G.; Ford, G. W. K.; Gregory, J. N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1974. 50p. Dep. NTIS (US Sales Only) $5.50.

Literature evaluating the potential use of gamma radiation for the treatment of sewage is critically reviewed. It is concluded that irradiation treatment cannot contribute significantly to the improvement of conventional processes for sewage water recovery. Irradiation methods at present have no cost or technical advantage, and no proven biological advantage over known treatment systems. (auth)

25981 (EUR-5126d/e/f/i/n, pp 231-234) METABOLIC DETECTION OF POTATO IRRADIATION. Penner, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe). 1974.

In international colloquium, the identification of irradiated foodstuffs.

For the purpose of sprout-inhibition potatoes are irradiated with doses of up to 15 krad. The energy thus absorbed by the tissue does not suffice to cause measurable radiation-chemical changes. On the other hand, this dose causes irreversible damage to the genom of the cells, leading to inhibition of cell division. Measurable changes are therefore to be expected in those metabolic reactions which are associated with cell division. When a mature potato tuber is damaged, the cell layer adjacent to the wound surface is redifferentiated and regains the ability for cell division. This process is inhibited by irradiation. The effect of radiation on the process of wound-healing expresses itself on three planes: (1) changes in enzyme patterns, (2) changes in the amounts of metabolites, and (3) histologically recognizable effects on processes of cell division. Principally, effects observed on each of these planes permit conclusions regarding prior irradiation. In practice, however, the changes of proving a radiation treatment are limited by: (1) varietal differences, (2) biological variation within one variety, and (3) limited wound-healing ability of tubers after prolonged storage. (auth)

25982 (EUR-5126d/e/f/i/n, pp 325-328) IDENTIFICATION OF IRRADIATED POTATOES. Sparenberg, H. 1974. (In Dutch).

In international colloquium, the identification of irradiated foodstuffs.

Three institutes in Germany, France, and Belgium have cooperated in the development of methods for the identification of irradiated potatoes. The results obtained are tabulated and show that the best results are obtained with biological measurement methods. (JSR)

25983 LABORATORY TESTS OF CHROMIUM-51 COMPLEXES FOR LEAK DETECTION IN PIPES CARRYING A LIQUID FLOW. Kim, Y. S. (Korea Atomic Energy Research Inst., Seoul); Lee, B. H. J. Korean Nucl. Soc.; 6: No. 4, 231-237(Dec 1974).

For detection and localization of leaks in closed vessels or pipes carrying liquids, ^{51}Cr-EDTA and ^{51}Cr-DTPA were synthesized and column and batch equilibrium experiments were carried out. In the column experiment, the recovery of ^{51}Cr-EDTA is 100% in quartz sand and 80.9% in steel sawdust, and that of ^{51}Cr-DTPA is 77.4% in quartz sand and 6.4% in steel sawdust. The recovery curve for the ^{51}Cr-DTPA system in steel sawdust does not show a definite plateau. In general, ^{51}Cr-EDTA is adsorbed less than ^{51}Cr-DTPA. In the batch equilibrium experiment, the distribution coefficients (Kd) and effect of pH were investigated by using quartz sand, montmorillonite, steel sawdust, and mixed cement raw material as media. In general, the Kd values for ^{51}Cr-EDTA were lower than that of ^{51}Cr-DTPA. The Kd values for ^{51}Cr-EDTA were almost zero at pH 6.0, 7.0, and 8.0. (auth)

25984 METODIKA TEKHNIKO-EKONOMICHESKOGO ANALIZA PRIMENENIYA RADIOIZOTOPNYKH SPEDSTV KONTROLYA V TEKHNIKE. (Methods for the Technical Economics Analysis of the Use of Radioisotopic Control Methods in Industry). Akopov, V. S.; Mymrin, Yu. N.; Postnikov, V. I. Moscow; Atomizdat (1974). 200p.

The methodology for the technical-economic analysis of the introduction of radioisotopic control methods in industry is discussed. The indicators used in the analysis, methods for determining them, and factors affecting them are described. The results of a technical-economic study made during the development and introduction of new radioisotopic control methods for wear measurements and quality control of machine units are reported. The relations used by engineers and economists as a basis for the development of new techniques are given. (tr-auth)

25985 CONCRETE-POLYMER COMPOSITE MATERIALS PRODUCED BY RADIATION POLYMERIZATION TECHNIQUES. McLaren, K. G. (Australian Atomic Energy Commission, Lucas Heights); Samarin, A. pp 137-155 of First Australian Conference on Engineering Materials. Kensington, Australia; Unisearch Limited (1974).

From first Australian conference on engineering materials; Sydney (26 Aug 1974).

Concrete-polymer composites represent a comparatively new class of structural materials, still in the developmental stage. They are usually made by impregnating the interstices of precast concrete with suitable liquid monomers and converting these to solid polymers in the concrete. The composite materials have strength properties greatly superior to those of the base concrete. Results of some exploratory studies of the production and properties of concrete-polymer composites, in which gamma radiation was used to polymerize the monomer in the concrete are presented. With polymethylmethacrylate composites, compressive strengths up to 117 MPa, Brazil tensile strengths up to 8.95 MPa and elastic moduli up to 3.75×10^4 MPa were obtained with polymer loadings around 4.7%. Composites made from porous concrete (Besser brick) and polyester resins had compressive strengths around 145 MPa. The main factor influencing the degree of enhancement of strength properties is the total polymer loading achieved, and the ultimate strength attainable in the composites is largely independent of the type of concrete used to make the composite. Because of the inherently low thermal stability of the polymer component, composites for structural purposes would be restricted to applications where they would not be exposed to fire. Uses envisaged for these new materials include drain piping in corrosive environments, underwater structures, bridge decking and decorative panelling. The polymerization process can be accomplished by thermal means as well as by radiation and the method of choice for a given application will depend largely on the relative costs. (auth)

25986 SPECTROMETRIC METHOD FOR DETERMINING THE DISTRIBUTION OF α-ACTIVE SUBSTANCES BY THE DEPTH OF THE SOURCE. Bogolapov, N. V.; Gol'dshtein, D. S.; Ivanova, Z. M.; Konstantinov, I. E.; Kononovich, A. L.; Klochkov, V. N.; Soldaeva, L. S. pp 258-268 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (ed.). Moscow; Atomizdat (1974). (In Russian).

The principles of a spectrographic method for the determination of the depth of penetration of α particles in materials are outlined. The sensitivity matrix was calculated for ^{239}Pu. The method was applied to the measurement of the diffusion of ^{239}Pu in polyvinyl chlorides. The abnormal characteristics of ^{239}Pu diffusion were clearly shown by the spectrographic method. (JSR)

25987 PROGRESS IN THE TECHNICAL APPLICATION OF ISOTOPES. Winkhaus, G. (Vereinigte Aluminium-Werke A. G., Bonn (F. R. Germany). Leichtmetall-Forschungsinstitut). Atomwirt., Atomtech.; 19: No. 11, 546-550(Nov 1974). (In German).

The survey gives examples of latest isotope applications in analysis technique, in wear measuring and in process engineering. Special emphasis is put on the importance of cooperation between radionuclide engineers and specialists in the corresponding sector of application. For the last ten years the statistic shows an average increase of the number of industrial appliers of radionuclides in the FRG by 8%/a. (auth)

25988 CALIFORNIUM-252 PROGRESS, NUMBER 18, FEBRUARY 1975. Californium-252 Progr.; No. 18, 1-48(Feb 1975).

Progress is reported on the use of ^{252}Cf in radiotherapy, neutron radiography, process control, neutron activation analysis, pollution control, quality control, and natural resources exploration. (TFD)

25989 RADIOACTIVE GREASE CONTAINING ^{85}Kr. Fries, B. A. (to Chevron Research Co.). US Patent 3,865,736. 11 Feb 1975. Filed date 9 Aug 1973. 10p.

A radioactive tracer system for indicating drill bit wear or failure utilizing radioactive krypton-85 dissolved or dispersed in an organic or metal organic thickened grease is described. Preferably the radioactive krypton is placed so that when drill bit wear or failure occurs, the radioactive krypton-85 is released and effectively becomes diffused in the circulating drilling fluid. At the surface, the radioactive krypton-85 gas is separated from the circulating drilling fluid by gas-mud separating means and is transported as a gas to a counting chamber where an accurate radioactivity count of beta rays released from the krypton is obtained. The beta rays indicate drill bit wear or failure when detected above the normal background radioactivity of the recirculating drilling fluid. (Official Gazette).

25990 METHOD AND APPARATUS FOR MEASURING GAS FLOW. Spragg, W. T.; Seatonberry, B. W. (to Australian Atomic Energy Commission). US Patent 3,866,057. 11 Feb 1975. Priority date 24 Mar 1972, Australia. 10p.

The invention is an apparatus and method for the absolute measurement of the mass flow rate of a gas by injecting a radioactive tracer isotope, with a known activity relative to a standard volume, into the flowing gas and measuring the activity when a small sample representative of the flowing gas is removed at a sampling point downstream of the injection point at a sufficient distance to ensure a homogeneous mixture of the tracer isotope with the flowing gas. The measured activity may then be used to determine the mass flow rate of the gas. (Official Gazette)

25991 IRRADIATOR APPARATUS. Woodbridge, D. D. (to McMillin Investments, Inc.). US Patent 3,865,734. 11 Feb 1975. Filed date 24 Oct 1972. 6p.

An irradiator of the type using radioactive material as a source of radiation having a casing for holding an irradiator core and inputs and outputs passing through the casing to the core is described. The core includes a plurality of concentric walls forming chambers with the flow of fluid passing from one chamber to the next and then out of the irradiator. A plurality of radiation sources

are located in the core and a system for feeding predetermined gases through a liquid being treated in the core and for bleeding excess gases out of the core is provided. The gas inputs are located to provide a turbulence in the liquid along the walls for keeping the irradiator clean as well as for increasing the effectiveness of the irradiator and the use of pre-selected gases improves the treatment by the combined action of the gases and irradiation of the fluid. (Official Gazette)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 26023, 26034, 26050, 26199, 28918, 28919, and 28943.

25992 (COO-3521-145) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Proposal No. 5. Chemical and Biological Studies on Nucleic Acids and Derivatives. Progress Report, May 1, 1973–October 1, 1974. Brown, G. B.; Bendich, A. (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 15 Oct 1974. Contract AT(11-1)-3521. 17p. Dep. NTIS $4.00.

An attempt was made to elucidate the chemistry of purine N-oxides in the excited state, to evaluate their potential as sources of radicals, to consider possible routes of their natural formation, and to assess the importance of this to oncogenesis. The stable free-radical photochemically induced in solid purine N-oxide derivatives was characterized as an amidogen radical delocalized through both rings. A fetal component (antigen) present in a mouse tumor was partially characterized. (CH)

25993 (COO-3521-146) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Proposal No. 6. Physical and Chemical Studies on Nucleic Acids and Derivatives. Progress Report, May 1, 1973–October 1, 1974. Cavalieri, L. F. (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 30 Oct 1974. Contract AT(11-1)-3521. 8p. Dep. NTIS $4.00.

The kinetics of DNA synthesis was studied using a number of RNA templates, both natural and synthetic and a variety of DNA polymerases from Escherichia coli. (CH)

25994 (SGAE-2340) INFLUENCE OF COMPOUNDS PRODUCED BY SUGAR RADIOLYSIS IN THE PRESENCE OF BIVALENT CATIONS ON DNA-REPAIR. Haesen, G.; Klein, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Forschungszentrum). Oct 1974. 11p. (CONF-731215-4; BL-109/74). Dep. NTIS (US Sales Only) $4.00.

From International symposium on DNA-repair and late effects; Vienna, Austria (6 Dec 1973).

Radiolysis of sugar produces desoxysugars, low-molecular-weight carbonyls such as malondialdehyde, formaldehyde, glyoxal, organic peroxides and α, β-unsaturated carbonyl sugars. These products of sugar radiolysis are found to be toxic. The bifunctional aldehydes, glyoxal and malondialdehyde interact with DNA "in vitro" and "in vivo" and cause a blocking of DNA-replication and protein-synthesis in human fibroblasts. Chromosomal breaks in human lymphocytes are produced "in vitro" by irradiated sucrose. Based on the discussed correlation between chromosomal aberrations and inhibited DNA-repair gradient centrifugations were performed in alkaline sucrose to measure the effect of compounds derived from radiolysis of glucose in regard to DNA-repair. Mouse spleen cells were treated with glucose solutions, irradiated with gamma rays up to 2 Mrad, and the rejoining of DNA single-strand-breaks, caused by gamma rays, was measured after 30 minutes at 37°C. (auth)

25995 EFFECT OF X IRRADIATION ON FRUCTOSE 1,6-DIPHOSPHATASE ACTIVITY IN RED BLOOD CELLS. Moisiu, M.; Florea, M.; Ababei, L. (Inst. of Public Health and Medical Research, Iasi). Stud. Biophys.; 46: No. 1, 73-77(1974).

Fructose 1,6-diphosphatase activity, made evident in human, rabbit and rat red blood cells (RBC) is inhibited after whole-body x irradiation. The inhibition of enzymatic activity increases with increase in the irradiation dose. Reduced glutathione and cysteine protect and reactivate the enzyme after inactivation by x irradiation. (auth)

25996 ADVANCES IN RADIATION RESEARCH. Biology and Medicine. Volume I. Conference held at Evian, France, June 29–July 4, 1970. Duplan, J. F.; Chapiro, A. (Eds.). New York; Gordon and Breach, Science Publishers, Inc. (1973). 489p. (In English and French). CONF-700610-P2 (B and M) $36.00.

Separate abstracts were prepared for the 42 papers included. (CH)

For abstracts of individual papers see: 25997–26013, 26020–26024, 26051–26054, 26061, 26085–26089, 26118–26123, 26186, and 26198–26200.

25997 ENZYMATIC EXCISION OF THYMINE DIMERS FROM UV-IRRADIATED DNA. Grossman, L.; Kushner, S. R.; Kaplan, J. C.; Mahler, I. (Brandeis Univ., Waltham, MA). pp 1-8 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The role of enzymatic excision of thymine dimers in the repair of uv radioinduced strand breaks in Micrococcus luteus was studied. Single-stranded DNA labeled with tritium was used to determine the site for the initiation of hydrolysis by exonuclease and the combined effects of endonuclease and exonuclease on the release of nucleotides by uv irradiated DNA and the role of these enzymes in repair processes. (CH)

25998 FORMATION AND REJOINING OF STRAND BREAKS PRODUCED IN MAMMALIAN DNA BY X-RAYS: AT DIFFERENT STAGES OF THE CELL CYCLE. Lett, J. T. (Colorado State Univ., Ft. Collins). pp 9-22 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

An improved alkaline sucrose gradient technique has been used to study the strand breaks produced in mammalian DNA by x rays. The efficiency for the formation of total strand breakage is 60 ± 10 eV at all stages of the cell cycle. Heavily irradiated cells rejoin strand breaks efficiently throughout the cell cycle. There seem to be at least two mechanisms involved in the rejoining process. (auth)

25999 REPAIR MECHANISMS RELATED TO DNA INTEGRITY (AND SURVIVAL) IN MAMMALIAN CELLS. Elkind, M. M. (Brookhaven National Lab., Upton, NY). pp 23-38 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Two mechanisms for x radiation damage repair of DNA in cultured hamster cells are demonstrable using the alkaline sucrose gradient technique. One of these is similar to what has been reported by others and probably represents single break repair due to a DNA ligase-type action. The second repair process is new and refers to the material we call the complex and which has a radiation target size eight times or more larger than the material in which single breaks are repaired. In respect to DNA damage measured by the techniques presented and cell killing measured by the loss of cell proliferation, data indicate that the integrity of the complex is important. Changes in sedimentation of the complex are observed after doses in the measurable cell survival range. While actinomycin D does not prevent single-break repair, it interferes with repair of the complex. The relevance of such correlations to the central problem of radiation cell killing is being actively pursued. (auth)

26000 RECONSTRUCTION OF CHROMOSOMAL DNA IN IRRADIATED CELLS BY POST-REPLICATION RECOMBINATIONAL REPAIR. Rupp, W. D.; Iyer, V. N.; Zipser, E. (Yale Univ., New Haven). pp 39-50 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Synthesis of Escherichia coli DNA on templates containing damaged bases produces new strands that have gaps at intervals similar to the expected distance between radiation products on the template strand. The size of these gaps in uv-irradiated cells was estimated to average about 1600 nucleotides missing per gap. These new short strands are joined into long continuous strands if the bacteria have the recA$^+$ gene. By the use of density label techniques, covalent joining of old parental strands to new strands synthesized after uv-irradiation was detected. These results are consistent with the proposal that when DNA containing radiation products in the template strand undergoes replication, then exchanges between homologous DNA molecules are involved in the construction of new functional DNA strands of high molecular weight. (auth)

26001 DNA REPLICATION AND REPAIR. Radman, M. (Univ., Brussels). pp 51-62 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The repair of pyrimidine dimers in uv irradiated Escherichia coli and bacteriophage in relation to the repair of radiation injury is discussed. It is suggested that the control of DNA replication is one of important factors for an efficient DNA repair, and that DNA replication itself can cause biological inactivation, probably when it occurs before the continuity of parental strands has been established. (CH)

26002 CORRELATIONS BETWEEN HOST-CELL REACTIVATION, UV REACTIVATION, AND PYRIMIDINE DIMER EXCISION IN THE DNA OF PHAGE LAMBDA. Boyle, J. M.; Setlow, R. B. (Oak Ridge National Lab., TN). pp 63-71 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The hypothesis is presented that dimers in bacterial DNA compete for endonuclease molecules, causing the number of single-strand breaks in λ DNA to be reduced, but not appreciably reducing the excision of λ dimers, since the rate-limiting step is that of the excision-specific exonuclease. UV reactivation occurs because breaks which are also sites for nonspecific exonuclease activities are not left open for appreciable lengths of time. Host-cell reactivation of phage λ involves the excision of pyrimidine dimers by host-cell enzymes. Host-cell enzymes preferentially excise dimers from host-cell DNA but dimers in λ DNA limit the excision of bacterial dimers better than the converse situation. UV reactivation of λ does not involve enhanced pyrimidine dimer excision. (auth)

26003 IN VITRO STUDIES ON THE REPAIR OF DAMAGED DNA BY BACTERIOPHAGE T4. Friedberg, E. C.; King, J. J. (Walter Reed Army Inst., Washington, DC). pp 73-81 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

In vitro studies on the repair of ultraviolet-irradiation damage to DNA in T4-infected Escherichia coli cells confirm many of the hypotheses forwarded on the basis of previous in vivo studies on dark repair. Dimer excision is a multienzyme process, requiring in addition to a highly specific endonuclease, other nucleases and probably synthetic and joining enzymes. The specificity of the T4 excision repair enzyme toward pyrimidine dimers in DNA confirms that dimers are a major and perhaps the only lethal photoproduct in DNA irradiated at very low doses. The observations that this enzyme also degrades alkylated DNA raises the intriguing possibility that the dark repair system as we currently understand it may be capable of repairing a variety of physico-chemical modifications in DNA. (auth)

26004 GENETIC CONTROL AND CHEMICAL INHIBITION OF THE REPAIR OF RADIATION DAMAGE TO BACTERIAL DNA. Kapp, D. S.; Smith, K. C. (Stanford Univ., CA). pp 83-93 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Recombination deficient mutants of Escherichia coli were found to be sensitive to uv irradiation and very sensitive to x irradiation. Two events at the molecular level that are related to repair of radioinduced strand breaks of DNA were found to be governed by certain genes controlling genetic recombination. These were the repair of single-strand breaks in both parental strands following exposure to x radiation and repair of gaps in DNA in the daughter strand of each DNA duplex after exposure to uv radiation. Inhibition of radioinduced damage by preparations of hydroxyurea and the potentiation of radiation damage by acriflavine were observed. (CH)

26005 REPAIR IN E. COLI AFTER SPECIFIC THYMINE DIMER FORMATION. Mennigmann, H. D.; Martignoni, K.; Pons, F. W.; Froehlich, W. (Univ., Frankfurt am Main). pp 95-107 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The role of pyrimidine dimers in the biological effects of uv irradiation on Escherichia coli was investigated. Results are reported from studies of lethal and mutagenic lesions in DNA and the effects of photochemical reactions involving pyrimide dimers on biological repair of radioinduced strand breaks. (CH)

26006 REPAIR OF CYTOPLASMIC GENETIC DAMAGE IN YEAST. Moustacchi, E.; Enteric, S. (Institut du Radium-Biologie, Orsay, France). pp 109-118 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The relationship of mechanisms governing the induction and repair of uv radioinduced lesions of DNA in the cell nucleus to the induction and repair of lesions in cytoplasmic mitochondria in Saccharomyces cerevisiae was studied. The response of 21 independent uv-sensitive nuclear mutants to the induction of lesions in cytoplasmic mitochondria was followed. Results showed no apparent correlation between the degree of uv-sensitivity of nuclear and cytoplasmic constituents. (CH)

26007 CHARACTERIZATION OF GENETIC CODING CHANGES IN BACTERIA PRODUCED BY THE RADIOACTIVE DECAY OF INCORPORATED ^{3}H- AND ^{14}C-LABELED COMPOUNDS. Person, S.; Phillips, S. L.; Andersen, F. A.; Newton, H. P. (Pennsylvania State Univ., University Park). pp 159-168 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Mechanisms for the induction of mutations in Escherichia coli by the transmutation of ^{3}H or ^{14}C incorporated in labeled compounds in the bacteria are discussed. Molecular changes in DNA and RNA the lead to mutation are described. (CH)

26008 RADIOTOXICITY OF INTRACELLULAR DECAY OF IODINE-125. Hughes, W. L.; Hofer, K. G.; Prensky, W. (Tufts Univ., Boston). pp 181-188 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The similarity of toxicities of ^{131}I and ^{3}H incorporated into the DNA of mouse tumor cells noted despite their very disparate decay energies can be explained on the basis of the fraction of their electron energies deposited within cell nuclei. However, the toxicity of ^{125}I is much greater than can be attributed to its energy deposition within the cell nucleus. It is postulated that the increased toxicity is due to the localization of ^{125}I within a radiosensitive volume considerably smaller than the cell nucleus. (auth)

26009 STABILITY OF THE EUKARYOTE CHROMOSOME TO TRANSMUTATION OF CARBON-14 TO NITROGEN-14 WITHIN DNA MOLECULE. Lee, W. R.; Sega, G. A. (Louisiana State Univ., Baton Rouge). pp 189-194 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Studies in Drosophila melanogaster showed that transmutation of ^{14}C within the DNA molecules, like transmutation of ^{32}P, does not break the eukaryote chromosome or induce lethal mutations that are present in all the cell lineage, and ^{14}C is less effective than ^{32}P in inducing lethal mutations that are present in only some of the treated cells' lineage. For practical purposes in considering mutagenic hazards or toxicity effects due to chromosome breakage, only the beta radiation of ^{14}C needs to be considered. (auth)

26010 SENSITIVITY OF BACTERIOPHAGE α DURING INTRACELLULAR DEVELOPMENT IN BACILLUS MEGATERIUM TO GAMMA-IRRADIATION AND THE DECAY OF INCORPORATED ^{32}P ATOMS. Taylor, W. D.; Strniste, G. F. (Pennsylvania State Univ., University Park). pp 195-201 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The effect of ^{32}P transmutation on developing complexes of bacteriophage of Bacillus megaterium was measured. The complexes are as sensitive as free phage during the eclipse period (20 minutes). Rifampin inhibited phage development if added during this period and also arrested the decrease in sensitivity of complexes to γ and x rays. It was concluded that the effects of both ^{32}P and x ray inactivation of complexes can be explained in terms of transcription rather than DNA replication or a repair system. (auth)

26011 RADIATION SENSITIZATION AT THE MOLECULAR LEVEL. Quintiliani, M. (Istituto Superiore di Sanita, Rome).

pp 203-217 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Some of the mechanisms responsible for radiosensitization phenomena in chemical model systems are discussed. Emphasis is placed on molecular events in aqueous solutions of enzymes sensitized with iodine compounds before being exposed to ionizing radiations. (CH)

26012 MECHANISM OF SENSITIZATION TO ULTRAVIOLET RADIATION OF 5-BROMOURACIL SUBSTITUTED DNA. Lion, M. B. (Israel Inst. for Biological Research, Ness-Ziona). pp 219-228 of Advances of radiation research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The following effects occur in 5-Bromouracil substituted DNA of T3 coliphage irradiated in vitro with uv light: Single strand breaks at very low doses; double strand breaks at higher doses; and base loss from the BU-DNA at equal rates for all bases tested; cysteamine was found to protect against all these changes. The sensitization of BU-DNA to uv is discussed in the light of these findings. (auth)

26013 MUTATION BY IONIZING RADIATION IN RELATION TO REPAIR AND REPLICATION. Bridges, B. A.; Green, M. H. L.; Munson, R. J. (M. R. C. Radiobiology Unit, Harwell, Eng.). pp 367-375 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Data are presented to show that γ irradiated DNA transferred during conjugation of Escherichia coli is not subject to most of the rec^+-dependent repair which normally occurs to ensure survival. It is concluded that most of the repair that goes on in a rec^+ bacterium occurs at or after DNA replication. The majority of single strand breaks induced by ionizing radiation must be repaired even in rec^- bacteria. A small proportion of the breaks may be complex and need the rec^+ and exr^+ genes for repair before DNA replication. This pre-replication rec^+ repair comprises not more than 15% of the total rec^+ repair. The simplest hypothesis for which evidence is presented, is that mutations arise to a significant extent only during the prereplicative repair of complex single-strand breaks by a process requiring both the exr^+ and rec^+ gene products. The greater part of rec^+ repair after ionizing radiation, although occurring at or after replication, differs in some respects from that after uv in being apparently non-mutagenic. (auth)

26014 COLLAGEN: A SURVEY OF RECENT BIOCHEMICAL STUDIES OF ITS STRUCTURE. Hall, D. A. (Leeds Univ., Eng.). pp 1331-1345 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

A background survey is provided of the way in which cross linkages affect the structure and stability of the collagen molecule. The changes in these cross linkages which occur with age and pathological conditions are also considered, since these may be of importance in determining the mode of action of radiation in its possible effects on collagen. (auth)

26015 BIOCHEMISTRY. Errera, M. (Univ., Brussels). pp 1481-1488 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

We feel, as already stated, that with the discovery of the genetic control of radiosensitivity — and it would be preferable to generalize and say DNA sensitivity, because all causes of DNA damage appear to be controlled by the same group of mechanisms — radiobiology has entered a new phase. It no longer belongs to a marginal group of applied sciences but has found its way into general biology. It cannot at present be doubted that the evolution of prebiological molecules and of primitive organisms took place in an environment where radiations played a prominent role, contributing to the synthesis of macromolecules capable of storing and replicating information but simultaneously by exposing these molecules to damage. It seems therefore very plausible that mechanisms for DNA replication leading to the multiplication of cells and organisms, repair controlling their genotypic and phenotypic stability, and mutations permitting the evolution of species, all arose somewhat simultaneously and obviously in a coordinated manner. We feel that one of the major contributions of this meeting is to have stressed the probable universality of repair mechanisms and perhaps opened a new path for studying evolution at the molecular level. (auth)

Radiation Effects on Cells

Refer also to abstracts 25994, 25996, 26008, 26085, 26086, 26089, 26092, 26145, 26152, and 28917.

26016 (AED-CONF-74-440-012) BIOLOGICAL EFFECTS OF X-RAY INDUCED AUGER EFFECTS. Tisljar-Lentulis, G.; Feinendegen, L. E.; Bond, V. P. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Medizin). 1974. 5p. (In German). INIS.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik e.V.; Freiburg im Breisgau, F. R. Germany (2 Oct 1974).

Incorporated radioisotopes whose decay is accompanied by the Auger effect are of high biological effectiveness. Vacancies on inner electron shells produced by photo effect should have the same effects as those due to electron capture or internal conversion. Monoenergetic rays whose energy corresponds to the K-absorption edge of the radiation-absorbing atoms combine a large effective cross-section for photo absorption with relatively low Compton scattering. Energies equal to the natural tissue components are too low to be able to produce effects in deep layers. Incorporation of heavier elements into cells and tissue, however, enables correspondingly higher energies to be used. A quality factor for the radiation efficiency allows optimum radiation-target combinations to be chosen for a given effect to be achieved by irradiation. Results of first experiments with human kidney cells either in culture medium or in the mouse sarcoma 180 are reported. The target element in these experiments was bromine incorporated into the DNA of cells. Irradiation was carried out with 14-keV strontium K_α-beams. For reasons of comparison, results obtained with incorporated ^{125}I as target element are also discussed. (GE)

26017 (COO-3521-143) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Proposal No. 2. Radiation Studies: Radiation Mechanisms in Mammalian Systems. Progress Report, May 1, 1973 – October 31, 1974. Laughlin, J. S.; Zeitz, L.; Djordjevic, B. (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 31 Oct 1974. Contract AT(11-1)-3521. 5p. Dep. NTIS $4.00.

The chronically hypoxic HeLa cell system was used to study the oxygen effect on radiosensitivity during the division cycle. With ^{60}Co γ and x irradiation the dose modifying effect of oxygen was higher in interphase than in mitotic cells. The radiobiological parameters, RBE and OER, of two fast neutron fields were studied. Results indicated that the radiobiological response, both for RBE and OER, of this HeLa cell system is dependent only upon the neutron dose and is independent, between 2 and 12 cm, of the depth in a phantom. (CH)

26018 (RLO-2226-T1-14) DEHYDROASCORBATE UPTAKE AND REDUCTION BY HUMAN BLOOD. Stankova, L.; Rigas, D. A.; Bigley, R. H. (Oregon Univ., Portland (USA). Medical School). [nd]. 11p. (CONF-741093-1). Dep. NTIS $4.00.

From second international conference on vitamin C; New York, New York, USA (9 Oct 1974).

Dehydroascorbate uptake and reduction and changes in glucose-C-1 oxidation during the incubation of human blood cells with dehydroascorbate were measured. Results indicated that dehydroascorbate reduction differs qualitatively in mature human neutrophils, lymphocytes, and erythrocytes. This finding supports the hypothesis that dehydroascorbate reducing capacity may be an important part of cellular mechanisms for inactivating oxidants and free radicals and therefore may affect the radiosensitivity of blood cells. (CH)

26019 THEORETICAL AND MODEL DESCRIPTION OF REPAIR OF CELL SYSTEMS DEPENDING ON AGE OF MITOTIC CYCLE PHASE AND DAMAGE DEGREE. Tyazhelova, V. G. (Inst. of Biological Physics, Puscino, USSR). Stud. Biophys.; 46: No. 1, 1-8(1974).

Postradiation kinetics was analyzed in the cells of rat intestinal epithelium in vivo. The survival curves obtained were compared with those of irradiated cultures in vitro. The hypothesis suggested describes the postirradiation repair process. Limited functional potentialities of the system and threshold level of damage are assumed to be the regulatory factors. Computer modeling was carried out and some quantitative characteristics of the repair process were obtained. (auth)

26020 RADIOSENSITIZERS FOR MAMMALIAN CELLS. Moroson, H. (Sloan-Kettering Inst. for Cancer Research, New York). pp 237-248 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Mammalian cells vary in their response to radiation due to various combinations of cell repair, progression through the cell cycle, state of the mitotic cycle, and release of humoral agents in vivo. The effects of various doses of oxidizing agents, reducing agents, antibiotics, uracils, membrane binding agents, and thiol binding agents on the x radiosensitivity of mouse tumor cells were investigated. Cell survival time was used as criterion for radiosensitivity. (CH)

26021 SENSITIZATION BY BUdR AND REPAIR OF RADIATION DAMAGE IN SYNCHRONOUS HeLa CELLS. Djordjevic, B. (Sloan-Kettering Inst. for Cancer Research, New York). pp 249-260 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Using synchronous HeLa cells, it was found that postirradiation incorporation of BUdR has a similar but not identical effect as preirradiation incorporation on decreasing survival of irradiated cells. Repair of potential lethal damage following exposure to x radiation was not affected in BUdR containing cells. (auth)

26022 SIMILARITIES AND DIFFERENCES BETWEEN UV AND IONIZING RADIATION DEATH. Painter, R. B. (Univ. of California, San Francisco). pp 411-419 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

It is postulated that DNA is the main target whose damage leads to cell death following exposure to either ionizing or ultraviolet radiation. A comparison was made of the amount of damage of DNA induced by uv and x radiation at equal dose levels in relation to the survival of Chinese hamster cells in cultures. Differences were found in the radiation dose required to produce strand breaks in DNA, in their effects during various stages of the cell cycle, and in repair mechanisms for sublethal damage induced by the two kinds of radiation. (CH)

26023 DNA BREAK REPAIR AND SUBLETHAL DAMAGE RECOVERY. Terasima, T. (National Inst. of Radiological Sciences, Chiba-si, JA). pp 421-429 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The capacity of mammalian cells to recover from sublethal radiation damage following exposure to ionizing radiation was studied using cultured mouse L cells exposed to two-dose fractionated irradiation with the introduction of cycloheximide (a protein synthesis inhibitor) or 5-fluorodeoxyuridine (a macromolecular synthesis inhibitor) between the two radiation exposures. The effects of proflavin and phleomycin (known to suppress the action of DNA-polymerase) on the recovery of the irradiated cells were also studied. The relationship of radioinduced breaks in DNA strands to recovery of cells from sublethal damage is discussed. (CH)

26024 CHROMOSOME ABERRATIONS: MECHANISMS OF CELL DEATH. Wolff, S. (Univ. of California, San Francisco). pp 457-465 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

It is quite clear that low doses of ionizing radiation kill cells by damaging the genetic apparatus within the nucleus. Of the three types of damage that could possibly be induced, i.e., effects on replication, mutation, and chromosome aberrations, correlations between the amount of damage and the dose of radiation show that only chromosome aberrations can account for the majority of cell death. Although it is commonly stated that the sensitive target is DNA, we, as yet, have no clear picture as to how such damage could induce chromosome aberrations and it would be more accurate to state that cell killing is caused by a genetic effect, an effect on the nucleus, or an effect on chromosome aberration induction. In all three cases a change in the amount or arrangement of the DNA would still be responsible for the final death of the cell. (auth)

26025 ADVANCES IN RADIATION RESEARCH. Biology and Medicine. Volume II. Conference Held at Evian, France, June 29-July 4, 1970. Duplan, J. F.; Chapiro, A. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1973). 1004p. (In English and French). (CONF-700610-P2(B and M)). $42.00.

Separate abstracts were prepared for the 48 papers included. (CH)

For abstracts of individual papers see: 26026-26040, 26056, 26057, 26062, 26067, 26096-26098, 26125-26146, 26188-26190, and 26232.

26026 INFLUENCE OF RADIATION QUALITY ON BASIC MECHANISMS OF RADIOBIOLOGICAL PROCESSES. Neary, G. J. (M. R. C. Radiobiology Unit, Harwell, Eng.). pp 467-478 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The influence of radiation quality on basic mechanisms of radiobiological processes is reviewed. It is pointed out that a single track which crosses a cell may make potentially lethal lesions at several places in the cell and even at several places in the same macromolecular target such as the DNA. This fact may account for some of the features of the dependence of cellular effects on radiation quality, but in general the identification of the molecular lesions responsible for the effects remains uncertain. (auth)

26027 DEPENDENCE OF DAMAGE IN MAMMALIAN CELLS ON RADIATION QUALITY. Barendsen, G. W. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 479-494 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The dependence on ionization density of several types of damage in mammalian cells, namely cell reproductive death, reduction in growth rate of clones, and mitotic delay, is discussed. Damage induced by densely ionizing radiations is less modified by dose fractionation or sensitizing and protecting agents and is less dependent on cell age as compared with x rays. Effects of fast neutrons of different energies can be interpreted qualitatively by consideration of dose-effect relations obtained with monoenergetic ions. (auth)

26028 EFFECT OF 14 MeV NEUTRONS ON MAMMALIAN CELLS IN VITRO. Ellis, R. E.; Lewis, J. D.; Lindop, P. J. (St. Bartholomew's Hospital, London). pp 501-509 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Hela cells were irradiated under oxygenated and hypoxic conditions, in vitro, with 14-MeV neutrons at a dose rate between 1 to 10 rads/min. The oxygenated data are compared with those from 2.5 up to 1000 rads/min. An increase in D_0 was seen with increasing dose rate. Intracellular recovery was significant at 6 to 8 hours after a first dose of 70 rads, but was not seen after 100 rads. The possible effect of the size of first dose is discussed. (auth)

26029 CHANGES IN THE BIOLOGICAL PARAMETERS FOR MAMMALIAN CELLS AS A FUNCTION OF POSITION IN A 14 MeV NEUTRON FIELD. Nias, A. H. W.; Greene, D. (Christie Hospital, Manchester, Eng.). pp 521-531 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The biological parameters for HeLa cells were determined along the depth and at the periphery of a 14-MeV neutron beam. Preliminary results indicate a minimal decrease in RBE values for cells irradiated at 10-cm depth in water in the central axis and in the penumbra in air. No significant difference was found in the values for OER. (auth)

26030 OXYGEN ENHANCEMENT RATIO FOR CALIFORNIUM-252. Fairchild, R. G.; Drew, R. M.; Atkins, H. L.; Robertson, J. S. (Brookhaven National Lab., Upton, NY). pp 533-539 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

HeLa S3 cells were irradiated in tissue cultures in glass

flasks under oxygenated and anoxic conditions. The results indicate that the OER for ^{252}Cf neutrons plus γ is about 1.3 for a dose rate of 15 rads/hour. (auth)

26031 HYPOXIC PROTECTION AGAINST LETHAL EFFECTS OF FAST NEUTRONS OF DIFFERENT ENERGIES, STUDIED IN A MURINE LEUKAMIA USING COLLIMATED EXTERNAL NEUTRON BEAMS, AND SIMULATED TISSUE IMPLANTS. Berry, R. J. (Churchill Hospital, Oxford); Brennan, J. T.; Goodman, L.; Lucas, A. C.; Quam, W.; Oliver, G. D. Jr. pp 577-586 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

For murine tumour cells irradiated at the surface of a tissue-equivalent phantom with collimated beams of fast neutrons, the protection afforded against lethal radiation damage by hypoxia varies inversely with the neutron energy. The Oxygen Enhancement Ratio (OER) ranges from 1.1 for fission-spectrum (circa 1 MeV) neutrons to 2.0 for cyclotron-produced neutrons of circa 25 MeV (50 MeV D-Be). This change in OER correlates well with the response of the same cells to irradiation with monoenergetic track segments of deuteron and alpha beams of known ionization density (LET). However, for irradiation of the tumour cells with collimated beams of fast neutrons at 10 cm depth in a tissue-equivalent phantom, the OER is uniformly lower than predicted by consideration of the average LET. (auth)

26032 BIOCHEMICAL EVENTS DURING THE MAMMALIAN CELL CYCLE. Petersen, D. F.; Anderson, E. C.; Tobey, R. A. (Los Alamos Scientific Lab., NM). pp 869-880 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The cycling mammalian cell in culture is one of the most important quantitative test objects in modern radiobiology, and the detailed biochemical description of cell culture systems is fundamental both for understanding radiation effects in vitro and for designing radiotherapeutic regimes. A brief review is presented to provide a biochemical framework for radiation effects and presents data on the pertinent features of cellular behavior in the unperturbed cycle in culture. (auth)

26033 TWO PRINCIPAL POINTS OF CONTROL IN THE MITOTIC CYCLE OF PEA MERISTEM CELLS: ENERGY CONSIDERATIONS, CHARACTERIZATION, AND RADIOSENSITIVITY. Van't Hof, J. (Brookhaven National Lab., Upton, NY). pp 881-894 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Cell population kinetic evidence is presented for the hypothesis that in the mitotic cycle of pea meristem cells there are two principal control points, one in G1 and the other in G2. Some of the metabolic and biochemical characteristics of the mitotic cycle are described and it is postulated that radiation-induced delay at G1 → S and at G2 → M reflected the recovery time of damaged cells. (auth)

26034 DAMAGE AND REPAIR IN DNA AS RELATED TO THE CELL CYCLE. Humphrey, R. M. (Univ. of Texas, Houston). pp 895-904 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Results are reported from studies of the radioinduction of single strand breaks of DNA in mammalian cells and mechanisms for recovery. It was concluded that the yield of breaks is uniform throughout the division cycle and therefore difference in quantity of this lesion cannot account for fluctuation in cycle sensitivity. The process resulting in the rejoining of single strand breaks is enzymatic in nature, and cells in all stages of the division cycle have the capability of rejoining breaks and the extensive synthesis of DNA, RNA, or protein is not required. Therefore, the enzymes necessary for this process are present and functional at all times in the division cycle. Cells in S phase can rejoin breaks at a faster rate than cells in mitosis, but the end result is that nearly all breaks are resealed in both phases of the cycle. Although it is probable that single strand breaks and their repair have biological significance, their role in determining radiation response is not established. (auth)

26035 CELL CYCLE DEPENDENT ULTRAVIOLET LIGHT SURVIVAL AND ITS RELATION TO X-RAY RESPONSE. Han, A. (Inst. Rudjer Boskovic, Zagreb). pp 905-915 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Results of studies on the age response for uv-induced lethality and division delay in Chinese hamster cells showed that largest effects occur when cells are irradiated in S. A markedly different age response for survival after uv and x ray exposure was found. The responses to the two types of radiation differ in that the maximum and minimum sensitivity to uv occur later in the cycle than the corresponding change in x-ray response. The most significant difference between the responses is the sensitivity of mitotic cells, which were found to be the most sensitive fraction toward x-rays and least sensitive toward uv. (CH)

26036 PLATEAU PERIOD CELLS AND CELL CYCLE EVENTS. Hahn, G. M.; Yang, S. J. (Stanford Univ., CA). pp 917-928 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Studies on cultured Chinese hamster cells showed that cells, in the presence of adequate nutrients, leave the cell cycle in the G1 phase. Most of such cells (unless subcultured) never enter S; it is therefore reasonable to assume that the growth-limiting control is along the pathway of DNA synthesis. In the absence of adequate nutrients, some cells leave the cycle during phases other than G1. Those cells that exit from the cycle during G2 either progress slowly through mitosis and are arrested again in G1 or else die. Cells leaving during S may be arrested in that phase for considerable time. Cells arrested in S during late plateau period may be G1 cells attempting to cycle but not quite making it through S. (auth)

26037 EFFECT OF RADIATION ON CELLS IN THE STATIONARY PHASE OF THEIR GROWTH. McNally, N. J. (Hammersmith Hospital, London). pp 929-937 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Tumor cells in culture were x irradiated in the logarithmic and stationary phases of growth. The only survival curve parameter to change was the extrapolation number which was reduced from four to one. Fed stationary cells encountered a block in G_1, while unfed ones experienced a doubling in the cell cycle time. Unfed stationary cells, unlike fed ones, were able to repair potentially lethal radiation damage. Though synchrony might be the explanation for the reduced extrapolation number of fed cells, this is not so for the unfed ones. (auth)

26038 INFLUENCE OF GROWTH PHASE AND CULTURAL CONDITIONS ON SURVIVAL OF IRRADIATED MAMMALIAN CELLS IN VITRO. Little, J. B. (Harvard Univ., Boston). pp 939-947 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The radiosensitivity of cultured mammalian cells varies with the growth phase of the culture, as well as with the time of trypsinization and plating in relation to irradiation. If plating is delayed for 6 hours after irradiation of stationary phase cultures, net survival is considerably enhanced. This effect appears to be due to the release by the cells of a diffusible substance which promotes the repair of potentially lethal damage in both stationary and exponentially growing cells. (auth)

26039 REPAIR OF POTENTIALLY LETHAL RADIATION DAMAGE IN PLATEAU PHASE CULTURES OF MAMMALIAN CELLS. Mauro, F.; Little, J. B. (Washington Univ., St. Louis). pp 949-958 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The repair of potentially lethal radiation damage has been shown to occur in 3 lines of cultures mammalian cells if they are allowed to remain in the plateau phase of growth for 2 to 24 hours after irradiation. Enhanced survival was characterized by an increase in slope of the survival curve, and the amount of repair was similar in all 3 cell lines, despite significant differences in their proliferative activities. (auth)

26040 CELL SYNCHRONIZATION BY RELEASING CONTACT INHIBITION AND ITS APPLICATION TO THE STUDY OF RA-

DIATION EFFECTS ON DIFFERENT STAGES OF THE CELL CYCLE. Yoshikura, H. (Institut du Radium, Orsay, France). pp 959-967 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Results are reported from studies on the effects of uv and x radiation on the growth of cultured mammalian cells at different stages of the cell cycle. A cell synchronization method by releasing the cells from contact inhibition is described. Cell cycle-dependent variations in radiation sensitivity of macromolecular synthesis and cell growth are described. (auth)

26041 KINETICS OF TUMOR CELLULAR PROLIFERATION: EFFECTS OF IRRADIATION. Hermens, A. F. (Radiobiological Inst., Rijswijk, Netherlands). pp 1129-1144 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The clinical results of tumor radiotherapy are determined by a large number of factors, including factors involved in cellular radiosensitivity, proliferation of surviving tumor cells as well as proliferation of cells doomed to die. These factors have also to be considered with respect to the radiation-induced damage of nonmalignant tissues. With respect to the possibility of increased cell proliferation occurring after treatment, no general conclusions can be drawn from the few studies discussed although such changes may be expected a priori if the growth fraction of unirradiated tumors is smaller than unity, and if their cells do not cycle maximally fast. (auth)

26042 VARIATION OF THE OXYGEN ENHANCEMENT RATIO AT DIFFERENT X-RAY DOSE LEVELS AND ITS POSSIBLE CLINICAL SIGNIFICANCE. Revesz, L.; Littbrand, B. (Karolinska Inst., Stockholm). pp 1215-1224 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Oxygen acts as a modifying agent to lethal damage and to recovery from sublethal damage. The summated results of efficient repair and increased cell damage will give an oxygen protecting or sensitizing ratio dependent upon the size of the radiation dose. Relatively low dose fractions are beneficial in the radiotherapy of essentially anoxic tumors, and large doses are of advantage for the treatment of tumors oxygenated by physiological processes or by hyperbaric oxygen. (auth)

26043 EFFECT OF STERILIZED TUMOR CELLS ON THE GROWTH OF ISOLOGOUS CELLS IN VIVO AND IN VITRO. Malaise, E. P. (Institut Gustave-Roussy, Villejuif, France). pp 1245-1251 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973). (In French)

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The NCTC 2472 cells sterilized by ionizing radiation reduce the number by 50% and stimulate the growth of isologous tumor cells in vivo. In vitro, they augment the plating efficiency and stimulate growth also. This is explained by a direct effect of sterilized cells that augment the coefficient of proliferation of small populations. (tr-auth)

26044 GROWTH OF CHINESE HAMSTER CELLS AS A TUMOR MODEL FOR STUDYING RADIATION EFFECTS. Sutherland, R. M.; Inch, W. R.; McCredie, J. A. (Ontario Cancer Treatment and Research Foundation, London). pp 1253-1269 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

This in vitro model simulates several properties of tumors in vivo, which are considered important in determining the final responses of the cells to radiotherapy. These include hypoxia and altered cell cycle kinetics. It has the advantage of simplicity compared with a tumor and its host and also survival of cells after treatment may be determined using standard tissue culture techniques. The model may be used to study the complex interactions among the several factors that modify the radiosensitivity of solid tumors. (auth)

26045 RADIORESISTANT CELL STRAINS OF THE L5178Y MOUSE LEUKEMIA: CROSS RESISTANCE TO METHOTREXATE. Courtenay, V. D.; Robins, A. B. (Inst. of Cancer Research, Sutton, Eng.). pp 1271-1279 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Radiation resistant cell strains derived from the mouse leukemia L5178Y grown in vitro have been found to be cross resistant to MTX. Cross resistance has also been found to the alkylating agents HN2 and DMM but not to 5FU. Resistance to MTX was found to be related to a decreased uptake of the drug into the cell. Cross resistance to radiation was not found in drug induced MTX resistant strains. (auth)

26046 IMPAIRMENT OF CELL REPRODUCTIVE INTEGRITY IN AN EXPERIMENTAL RHABDOMYOSARCOMA BY FAST NEUTRON AND GAMMA-IRRADIATION AT LOW DOSE RATES. Kal, H. B. (Radiobiological Inst., Rijswijk, Netherlands). pp 1281-1288 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

An experimental rat rhabdomyosarcoma was irradiated with low dose rate 15 MeV neutrons and ^{137}Cs gamma-radiation. During protracted irradiation repair of sub-lethal damage, reoxygenation and induced synchrony were shown to play a part. The RBE values for low dose rates are a factor 1.4 larger than for acute irradiations. (auth)

26047 RADIOSENSITIZATION OF HYPOXIC TUMOR CELLS BY HYPERTHERMIA. Kim, S. H.; Kim, J. H.; Hahn, E. W. (Sloan Kettering Inst., New York). Radiology; 114: No. 3, 727-728(Mar 1975).

The influence of hyperthermia on the survival of irradiated oxic and hypoxic HeLa cells was determined. A significant reduction in OER was obtained for irradiated cells subsequently cultivated at 42°C for two hours compared to irradiated cells cultivated at 37°C. These results suggest that heating irradiated hypoxic cells is an effective means of reducing the oxygen dependence factor in radiation effects. (auth)

26048 CELL-MEDIATED IMMUNITY AGAINST ALLOGENEIC TUMOR AFTER IN VITRO DEPLETION OF HISTOCOMPATIBILITY REACTIVE CELLS. Lukic, M. L.; Leskowitz, S. (Tufts Univ., Boston). Proc. Soc. Exp. Biol. Med.; 148: No. 2, 420-423(Feb 1975).

The capacity of a ^{3}H-thymidine hot pulse technique to remove lymphocytes reacting to histocompatibility antigens leaving those mediating tumor specific immunity was tested. The results demonstrated that a significant degree of immunity against tumor specific antigens is maintained in immune lymphocyte cultures deleted of immunologic reactivity to histocompatibility antigens by exposure to ^{3}H-thymidine hot pulse treatment. This finding represents an encouraging step in the efforts to prepare a lymphoid cell preparation adequate for clinical use in adoptive immunotherapy of a neoplastic disease by immunizing across histocompatibility barriers. (ERB)

Radiation Effects on Microorganisms

Refer also to abstracts 25275, 26004, 26006, 26025, 26066, 26100, and 26147.

26049 (AED-CONF-74-440-013) GROWTH KINETICS OF IRRADIATED YEAST CELLS (SACCHAROMYCES CARLSBERGENSIS). Rink, H.; Partke, H. J. (Bonn Univ. (F. R. Germany). Inst. fuer Biophysik). 1974. 18p. (In German). INIS.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik e.V.; Freiburg im Breisgau, F. R. Germany (2 Oct 1974).

Irradiated cells will lose their ability of forming new cells, the most frequently applied criterion to assess this ability being the colony-forming test. This method, however, yields little information about the biochemical and biological changes occurring during cell proliferation. In order to detect and identify these changes, cell proliferation was determined in a liquid culture medium. Overall time of cell cycle, lag time, and cell material were determined after completion of the exponential growth phase. Additional measurements of glucose consumption, ethanol formation, and O_2 consumption allow conclusions to be made with regard to the energy metabolism of irradiated cells during cell proliferation. The question of whether the giant cells frequently observed after irradiation have an increased metabolic capacity corresponding to their cell volume, or whether they are equal to normal cells is also discussed. (GE)

26050 (CNEA-381) RADIOPASTEURIZATION OF "MERLUCIUS–MERLUCIUS" FILLET. Part 2. Kaupert, N.; Ferreiro, N. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 16p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

The composition of amino acids in fish fillets (Merlucius–merlucius hubsi) exposed to a dose of 0.50 Mrad γ radiation was studied. The experiment was performed in order to evaluate the nutritional value of protein component from fillet that had been irradiated to extend its storage life at 4°C. The extraction and subsequent hydrolysis of fish proteins were made immediately after irradiation, at the same time control samples were processed. The results, obtained for each one of the analyzed amino acids, showed that there are no important changes of values due to irradiation effects. (auth)

26051 POSSIBLE MECHANISM FOR RADIOSENSITIZATION OF E. COLI BY IODOACETIC ACID. Gopal-Ayengar, A. R.; Joshi, D. S.; Shenoy, M. A.; Singh, B. B. (Bhabha Atomic Research Centre, Bombay). pp 229-236 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610–P1(B and M).

The iodine atoms released during the radiolysis of iodoacetic acid in the surrounding medium reacted mainly with the constituents of cellular membrane of Escherichic coli, affecting various post-irradiation processes such as syntheses of DNA and proteins and DNA degradation. Using Fenton's reaction, iodination of cells could be achieved without irradiation and the results obtained simulated the radiation effects. This further supports the view that the sensitisation was realised at the membrane level. (auth)

26052 MUTATOR ACTIVITY OF RADIATION-SENSITIVE MUTANTS OF YEAST. von Borstel, R. C.; Cain, K. T., Steinberg, C. M.; Resnick, M. A. (Oak Ridge National Lab., TN). pp 385-390 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Studies on x-radioinduced mutants of Saccharomyces showed that radiation-sensitive mutants of yeast vary in their inherent spontaneous mutability, both with respect to their frequencies and their types of mutational events. (auth)

26053 UV RADIATION-SENSITIVITY AND MUTATOR ACTIVITY IN YEAST SCHIZOSACCHAROMYCES POMBE. Loprieno, N. (Univ., Pisa, Italy). pp 391-395 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610–P1(B and M).

Ultraviolet-sensitive strains of Schizosaccharomyces pombe have been found to possess mutator activity. The responsible mechanism seems to be of the recombinational-repair type, since the uvs-mutations have been shown to be able to increase intragenic meiotic recombination. (auth)

26054 CELL MEMBRANES AS STRUCTURES RESPONSIBLE FOR THE OXYGEN EFFECT. Alper, T. (Hammersmith Hospital, London). pp 445-456 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610–P1(B and M).

From a variety of observations on Escherichia coli it was inferred that sensitization by oxygen to ionizing radiation is attributable to primary lesions in a site not affected by uv at germicidal wavelengths. Various experimental results support the hypothesis that this site is the cell membrane, not DNA. (auth)

26055 ISOLATION OF STOCKS OF PARAMECIUM AURELIA OF DIFFERENT RADIOSENSITIVITIES TOWARDS NATURAL IONIZING RADIATION. Croute, F.; Planel, H.; Soleilhavoup, J. P.; Blanquet, Y. (Toulouse-3 Univ., 31 (France)). Compt. Rend. Soc. Biol.; 167: No. 12, 1984-1989(1973). (In French).

Radiosensitive or radioresistant stocks of parameciae were isolated during 9 months, and a statistical analysis of the results was made. It was demonstrated that stocks of different radiosensitivities towards natural irradiation could be isolated. (FR)

26056 RECOVERY AND REPAIR OF RADIATION DAMAGE IN YEAST CELLS. Pohlit, W. (Gesellschaft fuer Strahlenforschung, Frankfurt am Main). pp 981-987 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Studies on diploid yeast cells showed that during irradiation with sparsely ionizing radiation radicals are produced from water molecules in the cell. These radicals can diffuse through the cell and can inactivate organic molecules. As a working hypothesis it should be assumed that the DNA is the essential molecule, responsible for the cell to be in state A or in B. The probability of a radical reaction with this essential molecule depends on the concentration of other organic molecules in its surrounding medium, which can compete with the DNA in radical reactions. If this concentration is high, the radiation sensitivity of the essential molecule is low. The effects of changes in the molecular structure on radiosensitivity are discussed. (CH)

26057 CORRELATION BETWEEN SENSITIVITY TO IONIZING RADIATION AND DNA REPLICATION IN PHYSARUM POLYCEPHALUM. Nygaard, O. F.; Brewer, E. N.; Evans, T. E.; Wolpaw, J. R. (Case Western Reserve Univ., Cleveland). pp 989-995 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

During the period of DNA replication the γ radiation sensitivity of the synchronously dividing plasmodial slime mold, Physarum polycephalum, in terms of delay of nuclear division, appears to be proportional to the amount of unreplicated DNA present at the time of irradiation. This result is discussed in terms of repair of damage to the DNA, inhibition of DNA synthesis, and complementation among active, undamaged genes. (auth)

26058 MICROBIAL STUDIES IN THE BIOSTACK EXPERIMENT OF THE APOLLO 16 MISSION: GERMINATION AND OUTGROWTH OF SINGLE BACILLUS SUBTILIS SPORES HIT BY COSMIC HZE PARTICLES. Horneck, G. (Univ., Frankfurt am Main); Facius, R.; Enge, W.; Beaujean, R.; Bartholomae, K. P. pp 75-83 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on life sciences and space research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

Bacillus subtilis spores were flown in the Biostack experiment aboard the Apollo 16 command module. The spores embedded in plastic foils were stacked between physical track detectors. The energy loss spectrum of the heavy particles of cosmic radiation was determined. Biological studies were restricted to the high-energy loss component of these particles. Spores that had received single hits whose positions were determined with a typical accuracy of ± 1 μm were investigated for radiation effects on germination and outgrowth. It was found that germination was not influenced by a hit by an HZE particle, but outgrowth was reduced significantly. (auth)

26059 ATTEMPT TO ESTABLISH THE IONIZING RADIATION DOSE TO BE USED IN THE STERILIZATION OF ONE-USE MEDICAL EQUIPMENT UNITS. Czerniawski, E.; Stolarczyk, L. (Univ., Lodz, Poland). Acta Microbiol. Pol., Ser. B; 6: No. 4, 177-183(1974).

The radioresistance of 8576 microbiological clones was examined. 8314 bacterial clones were isolated in the injection needle factory halls, from the surfaces exposed to strong ionizing irradiation sources. Those 649 clones which proved resistant to 2 to 4 Mrad radiation doses were used in further research work. The sterilizing value was based upon a detailed analysis of the bacteria according to their radioresistance groups and D_{10} values. The 3 Mrad doses have to be used in order to achieve the sterility degree of a 10^6 product series with an initial 100 microorganisms infection. In case of a 1000/one product bacteria infection limit, the dose should be raised to 3.5 Mrad. (auth)

26060 REDUCED ROT IN CITRUS FRUITS INOCULATED WITH PENICILLIUM ITALICUM BY USING COMBINED HEAT AND RADIATION TREATMENTS. Barkai-Golan, R. (Volcani Inst. of Agricultural Research, Rehovot, Israel); Kahan, R. S.; Padova, R. pp 1455-1461 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

An attempt was made to find the minimum dose of γ rays required in a combined treatment (heat) for the control of P. italicum in grapefruits and oranges, and also to determine the effect of reducing the temperature used. The results indicate that there is an optimal combined treatment for each host-pathogen system. Perhaps the most effective radiation dose at 50° or 52°C is above 50 krad but below 100 krad. A synergistic effect was observed in the combined treatments. (ERB)

Radiation Effects on Plants

Refer also to abstracts 26033, 26100, and 26147.

26061 COMPARISON OF MUTATIONAL CHANGES INDUCED BY ULTRAVIOLET LIGHT, ^{89}Sr GAMMA RAYS, X RAYS, AND CARBON IONS IN NEUROSPORA CRASSA. de Serres, F. J. (Oak Ridge National Lab., TN). pp 377-384 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

These data show that the ad-3 test system in a two-component heterokaryon provides an important new tool for characterizing the genetic effects of radiation with regard to the production of recessive lethal mutations. (auth)

26062 TRADESCANTIA EXPERIMENT IN BIOSATELLITE. II. Sparrow, A. H.; Schairer, L. A.; Marimuthu, K. M. (Brookhaven National Lab., Upton, NY). pp 675-687 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The combined effects of weightlessness and other environmental conditions in a space vehicle on the number of spontaneous and radioinduced mutations in Tradescantia were studied. The effects of environmental conditions were observed to be related to cell division and cell survival. (CH)

26063 NEUTRON INDUCED VARIEGATED MUTATION IN TAPIOCA. Nayar, G. G. (Bhabha Atomic Research Centre, Bombay). Curr. Sci. (India); 44: No. 6, 205(20 Mar 1975).

Fresh cuttings of tapioca (Manihot esculenta) variety H-97 were exposed to fast neutrons in doses ranging from 25 to 250 rad. The dose rate was 71 rad/min. One of the sprouts developing from a cutting exposed to 125 rad was a sectorial chimera with variegated leaves. Because of the low chlorophyll content of the leaves, growth of the variegated mutant was less vigorous. (ERB)

26064 RELATIVE ADVANTAGES OF FAST NEUTRON IRRADIATION TO INDUCE BUD SPORTS IN ORNAMENTAL PLANTS. Constantin, M. J. (Univ. of Tennessee, Oak Ridge). pp 1433-1443 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Results with Colorado White Sim carnation and other genera have demonstrated the value of fast neutrons to induce bud sports. Results of the studies with carnations demonstrated that neutrons are more effective than gamma rays for the induction of damage and the recovery of bud sports. At low levels of damage, neutrons are more efficient and at moderate levels of damage they are equally as efficient as gamma rays. Furthermore, neutrons can be used without encountering problems of dose rate and modification by environmental factors. (auth)

26065 X-RAY TREATMENT EFFECTS ON ALFALFA QUANTITATIVE TRAITS. Zannone, L.; Rotili, P. (Instituto Sperimentale per le Colture Foraggere, Lodi, Italy). pp 1445-1454 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Results of experiments concerning the effects of x-ray treatment on some quantitative characteristics (plant weight, plant height, stem number) of alfalfa grown under field conditions are presented. Seeds were exposed to 30 kR of x rays at 20°C in open air, seed moisture was 8.5%. The traits were observed at the blooming and budding stages. Quantitative measurements as effected by the seed treatment are given. (ERB)

26066 FUTURE OF THE USE OF RADIATION IN AGRICULTURE. Hall, N. S. (UT-AEC Agricultural Research Lab., Oak Ridge, TN). pp 1477-1480 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

It is the author's opinion that the use of radiation in agriculture is now coming into full realization. Two points, according to the author, should be examined: the latent effects of ionizing radiation in the agricultural system and the combination of radiation with other known treatments. Papers by previous authors at the conference are briefly reviewed. (ERB)

Radiation Effects on Animals

Refer also to abstracts 25996 and 26025.

26067 INTRODUCTORY REMARKS [ON NEUTRON RADIOBIOLOGY]. Ebert, M. (Christie Hospital, Manchester, Eng.). pp 495-499 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

A few of the difficulties encountered in biological studies using neutrons are discussed. Emphasis is placed on the need for internationally coordinated standards for neutron dosimetry. The need is stressed for experimental studies to establish dose fractionation schedules for the use of neutron beams for therapy of anoxic neoplasms in human patients. (CH)

Man

Refer also to abstracts 25764, 25767, 25927, 26041, and 26042.

26068 (AED-CONF-74-221-010) EVALUATION OF CASES PROBABLY INVOLVING RADIATION DAMAGE. Feinendegen, L. E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Medizin). 1974. 8p. (In German). INIS.

From 15th annual meeting on "The authorized physician within the meaning of the Radiation Protection Laws"; Karlsruhe, F. R. Germany (14 Jun 1974).

29 refs. With abstract.

In assessing the questionable damages especially in the limiting case of low doses, two aspects must be particularly considered: Where possible, evidence should be given as to whether an irradiation actually took place. The chromosome analysis of periphery blood lymphocytes is an additional help here. The risk estimation for the mostly non-specific effects with small dose rates and small doses must consider somatic and genetic effects equally in the light of the extraordinarily large repairing ability of the organism. (GE)

26069 (AED-CONF-74-509-017) A THEORETICAL AND EXPERIMENTAL EVALUATION OF TISSUE SUBSTITUTE MATERIALS. Wilson, I. J.; White, D. R. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). 1974. 16p. INIS.

From second symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

4 figs.; 9 tabs.; 43 refs. With abstract.

A comprehensive evaluation was made of the numerous tissue substitutes available for neutron dosimetry in the contexts of both radiological protection and radiotherapeutic simulation. More than 1,000 materials were analyzed theoretically, including those systems used in neutron and photon studies, and a wide range of inorganic and organic compounds, liquids, gas mixtures, polymers, and resins. Results of these analyses are discussed and a selection of the most useful materials are presented. A range of new substitutes was investigated experimentally by constructing a parallel plate ionization chamber in which plates of each material were inserted. Their responses relative to a standard, conducting tissue-equivalent plastic were measured in a flux of degraded fast neutrons. Comparisons of these data with the theoretical results and chemical analyses are made. The physical characteristics and applications of the new systems are discussed. (auth)

26070 (AED-CONF-74-509-022) MEASUREMENTS OF RADIATION COMPONENTS IN A PHANTOM FOR A COLLIMATED d-T NEUTRON BEAM. Mijnheer, B. J.; Broers-Challiss, J. E.; Broerse, J. J. 1974. 14p. INIS.

From second symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

4 figs.; 4 tabs.; 24 refs. With abstract. Available from ZAED.

In connection with the clinical applications of fast neutrons, depth-dose measurements in a phantom have been carried out for a collimated beam of 15 MeV neutrons (field size 6 × 8 cm) at target-to-skin distances of 45, 75 and 100 cm. Two different tissue-equivalent (TE) chambers have been employed for the determination of the total absorbed dose. Depth-dose measurements with the spherical chamber in the homogeneous liquid phantom, for a field size of 6 × 8 cm, have shown the 50% relative dose to be at 6.9 cm depth, 7.7 cm depth, and 8.5 cm depth for

target-to-skin distances of 45, 75, and 100 cm, respectively. The gamma component of the total dose was derived using a suitably shielded Geiger-Mueller counter as a gamma dosimeter. The contribution of the thermal and epithermal neutron fluence throughout the phantom was evaluated using the activation of gold foils with and without cadmium covers. The resulting values for the kerma due to thermal and intermediate energy neutrons is at maximum 0.2% and 0.03%, respectively of the total absorbed dose, at a depth of 3 cm in the phantom for a TSD of 45 cm. (GE)

26071 (CONF-730941-, pp 35-42) PION RADIOTHERAPY. Schwettman, H. A.; Bagshaw, M. (Stanford Univ., CA). 1973.

From grantees conference on instrumentation technology; Washington, District of Columbia, USA (25 Sep 1973).

In proceedings of the grantees conference on instrumentation technology.

The potential advantages of pion beams for radiotherapy are briefly reviewed. The design of a pion source that will reduce the size and cost of a hospital pion facility to a practical level is discussed. It is postulated that a 500 MeV proton accelerator or a 500 MeV electron accelerator could be adapted as a pion source. A schematic sketch of a medical pion generator and estimated cost factors are included. (CH)

26072 (CONF-730941-, pp 73-76) ACCELERATED PARTICLES IN RADIATION THERAPY. Powers, W. 1973.

From grantees conference on instrumentation technology; Washington, District of Columbia, USA (25 Sep 1973).

In proceedings of the grantees conference on instrumentation technology.

The biological and physical advantages of charged particles for radiotherapy of neoplasms are briefly reviewed. (CH)

26073 (CONF-730941-, pp 95-101) CALCIUM DETERMINATION IN BONE BY PROTON ACTIVATION. Bjarngard, B. 1973.

From grantees conference on instrumentation technology; Washington, District of Columbia, USA (25 Sep 1973).

In proceedings of the grantees conference on instrumentation technology.

The advantages of proton activation of calcium in human bones for in vivo measurements of changes in calcium content associated with osteoporosis and other metabolic diseases affecting calcium uptake by bones are discussed. (CH)

26074 (CONF-730941-, pp 102-110) APPLICATIONS OF PROTON RADIATION TO CANCER THERAPY. Koehler, A. M. 1973.

From grantees conference on instrumentation technology; Washington, District of Columbia, USA (25 Sep 1973).

In proceedings of the grantees conference on instrumentation technology.

Applications of the proton beam of the Harvard cyclotron for radiotherapy of selected neoplasms, primarily of the pituitary gland and retino-blastoma, are reviewed. It is pointed out that the small collimated beam limits injury of normal tissues. (CH)

26075 (CONF-730941-, pp 111-121) PROTON RADIOGRAPHY FOR DIAGNOSTIC PURPOSES. Steward, V. W. (Univ. of Chicago). 1973.

From grantees conference on instrumentation technology; Washington, District of Columbia, USA (25 Sep 1973).

In proceedings of the grantees conference on instrumentation technology.

The diagnostic potential of radiography using protons as the radiation source is discussed. Preliminary studies showed very high contrast radiograms using monoenergetic protons. (CH)

26076 (COO-3428-2) STUDY OF THE LIFETIME HEALTH AND MORTALITY EXPERIENCE OF EMPLOYEES OF AEC CONTRACTORS. Progress Report No. 8, August 1, 1971-July 31, 1972. Mancuso, T. F.; Sanders, B. S.; Brodsky, A. (Pittsburgh Univ., Pa. (USA). Dept. of Occupational Health). 25 Apr 1972. Contract AT(11-1)-3428. 110p. Dep. NTIS $8.50.

Preliminary results are reported from an epidemiological study of AEC and contractor personnel to ascertain whether or not any detectable life-shortening or increased mortality has occurred as a result of chronic exposure to low-dose radiation. A summary of the methodology used is included. A preliminary analysis of mortality of Hanford employees of 1944 to 1970 showed that the health hazards of employment within the atomic energy program are not grossly different from that of population groups used for comparison. (CH)

26077 (COO-3428-3) STUDY OF THE LIFETIME HEALTH AND MORTALITY EXPERIENCE OF EMPLOYEES OF AEC CONTRACTORS. Progress Report No. 9, August 1, 1972-July 31, 1973. Mancuso, T. F.; Sanders, B. S. (Pittsburgh Univ., Pa. (USA). Dept. of Occupational Health). 30 Jun 1973. Contract AT(11-1)-3428. 232p. Dep. NTIS $19.75.

Preliminary results are reported from an epidemiological study of AEC and contractor personnel to ascertain whether or not any detectable life-shortening or increased mortality has occurred as a result of chronic exposure to low-dose radiation. The methodology used is discussed. Preliminary data are presented on the mortality of Hanford employees as compared with that of their siblings. (CH)

26078 (COO-3428-5) STUDY OF THE LIFETIME HEALTH AND MORTALITY EXPERIENCE OF EMPLOYEES OF AEC CONTRACTORS. Progress Report No. 10, August 1, 1973-July 31, 1974. Mancuso, T. F.; Sanders, B. S. (Pittsburgh Univ., Pa. (USA). Dept. of Occupational Health). 30 Apr 1974. Contract AT(11-1)-3428. 219p. Dep. NTIS $14.00.

Progress is reported on an epidemiological study of the correlation of lifetime health and mortality of AEC and contractor personnel with occupational radiation exposure. Preliminary data on Hanford personnel are presented. No evidence was found that employees in general suffered adverse health effects because of their exposure to external low-dose whole-body radiation. (CH)

26079 (NP-20302) RADIOLOGICAL PROTECTION STANDARDS FOR THE POPULATION IN GENERAL AND CONTROL OF THE AMBIENT RADIOACTIVE CONTAMINATION IN MEXICO. Matluk, R. M. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Quimica). 1974. 145p. (In Spanish). Dep. NTIS (US Sales Only) $10.25.

Thesis.

The inherent risks of low-level irradiation doses on human beings are analyzed and the international standards are defined. The use of estimated risks to determine the dose limits to the population under normal and emergency conditions is discussed. The mechanisms for the transport of radioisotopes through the biosphere are described. The most dangerous radionuclides, critical population groups, and the most probable routes for the transport of the radionuclides to human beings are evaluated. The permissible contamination levels for Mexico are derived taking into consideration the habits and characteristics of the Mexican people. (JSR)

26080 (NYO-3394-5) FEASIBILITY STUDY OF THE CORRELATION OF LIFETIME HEALTH AND MORTALITY EXPERIENCE OF AEC AND AEC CONTRACTOR EMPLOYEES WITH OCCUPATIONAL RADIATION EXPOSURE. Progress Report No. 2, May 1965-May 1966. Mancuso, T. F.; Sanders, B. S.; Brodsky, A. (Pittsburgh Univ., Pa. (USA). Dept. of Occupational Health). 1966. Contract AT(30-1)-3394. 246p. Dep. NTIS $15.50.

This report is the second annual progress report of activities to test over a five-year period the feasibility of utilizing accumulated, routinely-recorded, personnel and radiation exposure data in AEC facilities for epidemiological studies of the health and mortality experience of atomic energy workers. The five-year test runs have been focussed on AEC plants at Oak Ridge (including the early University groups), Hanford, and several feed materials centers, to provide cohorts of atomic energy workers beginning employment in the years 1943 through 1964. The organizing, arrangements with other agencies, statistical design, data abstracting, and conversion to magnetic tape are discussed. (CH)

26081 (NYO-3394-9) FEASIBILITY STUDY OF THE CORRELATION OF LIFETIME HEALTH AND MORTALITY EXPERIENCE OF AEC AND AEC CONTRACTOR EMPLOYEES WITH OCCUPATIONAL RADIATION EXPOSURE. Progress Report Number 4, June 1, 1967-July 31, 1968. Mancuso, T. F.; Sanders, B. S.; Brodsky, A. (Pittsburgh Univ., Pa. (USA). Dept. of Occupational Health). 27 May 1968. Contract AT(30-1)-3394. 153p. Dep. NTIS $10.75.

Progress is reported on a study of the feasibility of an epidemiological study of the effects of chronic low-dose radiation exposure over varying periods of time on the health of AEC and contractor personnel. Computerized data processing programs, data accumulated during the fourth year of the study, and the possibility of including data on environmental exposures to agents other than radiation are discussed. (CH)

26082 (NYO-3394-11) FEASIBILITY STUDY OF THE CORRELATION OF LIFETIME HEALTH AND MORTALITY EXPERIENCE OF AEC AND AEC CONTRACTOR EMPLOYEES WITH OCCUPATIONAL RADIATION EXPOSURE. Progress Report Number 5, August 1, 1968-July 31, 1969. Mancuso, T. F.; Sanders, B. S.; Brodsky, A. (Pittsburgh Univ., Pa. (USA). Dept. of Occupational Health). 31 Dec 1969. Contract AT(30-1)-3394. 217p. Dep. NTIS $14.00.

The status of a study to determine the feasibility of an epidemiological study of the health hazards associated with chronic exposure to low-dose radiation is reviewed. Data collected during

a pilot study of AEC and contractor personnel at Hanford, Oak Ridge, early laboratories, and early feed mills are summarized and problems in data collection are identified. It is recommended that the study be extended to include all AEC contractor facility personnel and that standardized record keeping techniques be used to facilitate the incorporation of data into a computerized data compilation system. It is also recommended that data be included on environmental exposures to agents other than radiation. (CH)

26083 (NYO-3394-12) STUDY OF THE LIFETIME HEALTH AND MORTALITY EXPERIENCE OF EMPLOYEES OF AEC CONTRACTORS. Progress Report No. 6, August 1, 1969–July 31, 1970. Mancuso, T. F.; Sanders, B. S.; Brodsky, A. (Pittsburgh Univ., Pa. (USA). Dept. of Occupational Health). 27 Apr 1970. Contract AT(30-1)-3394. 138p. Dep. NTIS $10.00.

The status of data compilation on AEC and contractor personnel at Hanford and Oak Ridge to test the feasibility of using routinely-recorded personnel and radiation exposure data for an epidemiological study of the effects of chronic, low-dose radiation exposure on the health of man is reported. Computer programs were developed to identify the various environmental stresses to which each employee may have been exposed and to make rank correlations between medical and occupational radiation exposure, and also to provide mortality data when available. (CH)

26084 (NYO-3394-13) STUDY OF THE LIFETIME HEALTH AND MORTALITY EXPERIENCE OF EMPLOYEES OF AEC CONTRACTORS. Progress Report No. 7, August 1, 1970–July 31, 1971. Mancuso, T. F.; Sanders, B. S.; Brodsky, A. (Pittsburgh Univ., Pa. (USA). Dept. of Occupational Health). 29 Jul 1971. Contract AT(30-1)-3394. 301p. Dep. NTIS $18.25.

Progress is reported on an epidemiological study of the correlation of lifetime health and mortality of AEC and contractor personnel with occupational radiation exposure. A format and computer programs were developed that readily permit the extraction of radiation exposure data and that can be used to maintain lifetime exposure histories. Data obtained on personnel at Oak Ridge and Hanford were examined for ways to enhance the sensitivity of the study. (CH)

26085 MOLECULAR EVENTS FOLLOWING THE ULTRAVIOLET IRRADIATION OF HUMAN CELLS FROM ULTRAVIOLET-SENSITIVE INDIVIDUALS. Regan, J. D.; Setlow, R. B.; Carrier, W. L.; Lee, W. H. (Oak Ridge National Lab., TN). pp 119-126 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610–P1(B and M).

Cultured cells from uv-sensitive patients with xermoderma pigmentosum were examined for the uv induction of single strand breaks in DNA and the role of pyrimidine dimers and enzymes (nucleases polymerases, and DNA ligase) in repair mechanisms. Results showed an inhibition in the repair of uv radioinduced DNA strand breaks that was attributed to a lack of a functional form of the uv-endonuclease enzyme. (CH)

26086 DNA REPAIR AND CELL SURVIVAL IN HUMAN CELLS OF NORMAL AND XERODERMA PIGMENTOSUM GENOTYPE. Cleaver, J. E. (Univ. of California, San Francisco). pp 127-136 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610–P1(B and M).

Fibroblasts from patients with xeroderma pigmentosum (XP) perform reduced amounts of repair replication of DNA strand breaks and are more sensitive to killing after irradiation with UV light. XP fibroblasts repair damage from chemical mutagens to normal extents. Transformation by SV40 virus does not introduce the missing or defective UV repair enzyme in XP cells. (auth)

26087 X-RAY-INDUCED CHROMOSOME ABERRATIONS IN HUMAN LYMPHOCYTES IRRADIATED IN VITRO: THE INFLUENCE OF EXPOSURE CONDITIONS GENOTYPE AND AGE ON ABERRATION YIELDS. Evans, H. J.; Adams, A. (Western General Hospital, Edinburgh). pp 335-348 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610–P1(B and M).

The relation between radiation dose, radiation quality, ploidy of the cells, and age of the donor on the yield of chromosome aberrations in human lymphocytes x-irradiated in vitro is discussed. The yield of chromosome aberrations was determined in cultured cells. (CH)

26088 RADIATION-INDUCED CHROMOSOME ABERRATIONS AND THEIR IMPLICATIONS TO CELL KINETICS IN MAMMALS. Sugahara, T.; Tamura, H. (Kyoto Univ.). pp 349-366 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610–P1(B and M).

Studies on radiation-induced chromosome aberrations in peripheral lymphocytes in relation to their cell kinetics have been reviewed. The estimation of cell generation cycle based on exponential decay of cells with unstable abberations changes in the incidence of cells with unstable aberrations during radiotherapy in patients with cervical carcinoma with and without chemical protection, and chemicals-induced chromosome aberrations in human peripheral lymphocytes were discussed. (auth)

26089 KINETICS OF CELL REPRODUCTIVE INHIBITION. Bush, R. S.; Hill, R. P. (Princess Margaret Hospital, Toronto). pp 397-409 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610–P1(B and M).

The inability to relate information obtained from studies on the radiobiological response of experimental tumors in animals to the clinical practice of radiotherapy of neoplasms in patients is discussed. Possible explanations for differences in radiobiological response presented include the hypothesis that the radiation sensitivity of the tumor cell in human tumors is lower than that in animals; an immunological reaction exists against the human tumor but not that in animals; the size of the fraction of anoxic cells in human tumors is small or negligible; and the number of cells which have to be killed in human tumors is much less than in animals. (CH)

26090 PHYSICAL FUNDAMENTALS AND TECHNIQUE IN SOFT-TISSUE DIAGNOSIS. Gajewski, H.; Reiss, K. H. (Siemens A. G., Erlangen (F. R. Germany). Unternehmensbereich Medizinische Technik). Radiologe; 14: No. 10, 438-446(Oct 1974). (In German).

The soft tissue attenuation of x rays within the energy range up to 60 keV is demonstrated by diagrams and tables. By computerized calculation of roentgen-diagnostic problems and consideration of radiation exposure and tube loading it can be concluded: 1. Useful soft-tissue diagnosis is possible only by means of x-ray tubes with a low degree of pre-filtration (in particular mammography tubes) used in the voltage range between 20 kV and 40 kV to examine only relatively thin parts of the body. 2. For any object thickness there is an optimal radiographic voltage of the most favourable compromise between contrast and patient exposure. Finally, the value of other examination techniques (Xero-radiography, computerized tomography, neutron radiography) to extend the possibilities of soft-tissue diagnosis is discussed. (auth)

26091 RADIOBIOLOGICAL BASIS OF RADIOTHERAPY WITH SPECIAL REGARD TO TREATMENT WITH CORPUSCULAR RADIATION. Trott, K. R. (Muenchen Univ. (F. R. Germany). Strahlenbiologisches Inst.; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Biologie). Strahlentherapie; 148: No. 5, 451-462(Nov 1974). (In German).

From symposium on development trends in modern radiation therapy; Vienna, Austria (4 May 1974).

The radiobiological basis of radiotherapy of malignant tumours is discussed, especially with regard to the question of how the physical and biological properties of the various corpuscular radiations might be used to improve the therapeutic effectiveness. If the radiation effect on the tumour increases more than normal tissue damage, a true therapeutic gain can be achieved. Various properties of corpuscular radiations might do so: differences in dose distribution, increased effectiveness on hypoxic cells, differences in the capacity for recovery of sublethal damage and other less well studied factors. Their influence might vary between the various normal tissues and the various types of malignant tumours. Especially treatment with high LET corpuscular radiations demands knowledge of these various factors in human radiotherapy and thus above all a close cooperation between radiotherapist, radiation physicist, and radiobiologist. (auth)

26092 CYTOGENETIC RESEARCH IN GREAT BRITAIN. Lloyd, D. C.; Purrott, R. J.; Dolphin, G. W. (National Radiological Protection Board, Harwell (UK)). Rayonnements Ionis. Tech. Mes. Prot.; No. 3, 135-144(Jul 1974). (In French).

French translation not reviewed by the author.

Chromosomic analysis of the peripheral blood lymphocytes is considered very useful for the study of workers exposed to radiation and patients undergoing radiotherapy. It would even be an

ideal method of studying damage due to the use of new particles for radiotherapeutic purposes. A survey of the experimental studies at the origin of biological dosimetry is followed by a review of the application of chromosomic research in radioprotection and radiotherapy. The different cases encountered in radioprotection are divided arbitrarily into 4 categories for the sake of simplification: non-homogeneous exposure risk; known over exposure; presumed over-exposure in persons not carrying a dosimeter; chronic external or internal exposure. In radiotherapy, after pointing out that treatment often leads to high doses and that cytogenetic supervision has here proved very instructive, examples are given of the treatment of articular rheumatism by radioactive gold or yttrium, and long-term treatment of thyroid cancers by radioactive iodine. (FR)

26093 DETERMINATION OF THE ELECTRONIC DENSITY AND THE AVERAGE ATOMIC NUMBER OF TISSUES IN MAN BY γ-RAY ATTENUATION. Joyet, G.; Baudraz, A.; Joyet, M. L. (Univ., Zurich). Experientia; 30: No. 11, 1338-1341(15 Nov 1974).

26094 EXTENDED SOURCE MODEL IN THE CALCULATION OF THE PRIMARY COMPONENT OF THE DOSE OF TELECOBALT RADIATION. Habic, M.; Kmet, A. (Inst. of Oncology, Ljubljana, Yugoslavia). Radiobiol.-Radiother.; 15: No. 4, 481-485 (1974).

The choice of the most suitable functions for Wilkinson's extended source model and their agreement with measured data for various parameters of telecobalt radiation is discussed. A new parameter, describing the fall of the primary component of the dose at the edge of the beam better than this is done by the geometric penumbra, is introduced. (auth)

26095 ACCIDENTAL RADIATION EXPOSURE. Vodopick, H.; Andrews, G. A. (Oak Ridge Associated Universities, Inc., TN). Arch. Environ. Health; 28: No. 1, 53-56(Jan 1974).

A radiation accident is reported in which a technologist was in close proximity for 40 seconds to a source containing 7,700 curies of cobalt -60. The average bone marrow dose was estimated at 118 rads. Within the first 24 hours postexposure, lymphopenia developed and after two weeks, the platelet and granulocyte count began to fall and reached nadir at approximately four weeks. During the phase of granulocyte depression, the protective environment of a laminar airflow facility was believed to have lessened the risk of infection. This patient's hematological recovery was complete in six weeks. After exposure to higher doses of radiation than this patient received, recovery can occur if appropriate supportive care, ranging from rest and observation to marrow transplantation, is employed. The clinical course, laboratory data, and estimated dose-exposure will dictate what type of therapy is needed. Each case must be individually evaluated. (auth)

26096 CONSIDERATIONS RELATING TO FAST NEUTRON THERAPY. Bewley, D. K. (Hammersmith Hospital, London). pp 541-549 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Neutron beams of up to 14 MeV have inferior physical characteristics when compared with ^{60}Co γ rays or megavoltage x rays, both with respect to penetration and build-up under the skin. Use of radiotherapy treatment regimes customary with x-ray and γ rays may not represent the best way of using neutrons. To determine the value of fast neutron therapy it is necessary to use a beam of good physical characteristics and to find the regimes of treatment best suited to neutrons. (auth)

26097 OBSERVATIONS BY HUMAN SUBJECTS ON RADIATION-INDUCED LIGHT FLASHES IN FAST-NEUTRON, X-RAY, AND POSITIVE-PION BEAMS. Tobias, C. A.; Budinger, T. F.; Lyman, J. T. (Lawrence Radiation Lab., Berkeley, CA). pp 619-647 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

When a high-energy neutron beam from the Berkeley 184-inch cyclotron was passed through the region of one or both eyes in two human subjects, both subjects observed many small, star-like light flashes. The energy of the neutrons was greater than 20 MeV and less than 640 MeV, with maximum fluence around 300 MeV. At 1.4×10^4 neutrons sec^{-1} cm^{-2}, about 25 to 50 star flashes were seen at any given time in the visual field, seemingly more at the periphery and fewer at the center. The dose rate was about 0.1 mR/sec, or about 1.25 mrem/sec. The beam was on for several seconds. The same dark-adapted subjects observed no similar star-like flashes, over a period of 1 hour, when the beam was off. The subjects saw no such light flashes over 30- to 60-min periods in dark adaptation while flying in a plane at 10,000 meters at geomagnetic latitudes of 60°N and 40°N. A beam of π^+ mesons at the Berkeley Bevatron (momentum 1.5 GeV/c, fluence 200 mesons cm^{-2} sec^{-1}) failed to produce any kind of visual effect in one of the subjects, exposed for a total of 6 sec. A 250-kV x ray beam failed to produce any kind of light sensations at dose rate up to 1.25 mR/sec. This dose rate is 12.5 times the neutron dose rate that produced the star-like light flashes. It appears likely from the observations that star-like flashes in high energy neutron fields are due to high-LET nuclear recoils (from spallation) when the neutrons interact with the nuclei of tissue. Since most recoil nuclei travel too slowly to produce Cerenkov effect, it was concluded that the visual phenomena were due to ionization or excitation. (CH)

26098 HEAVY GALACTIC PARTICLES. Fowler, P. H. (Wills Physics Lab., Bristol, Eng.). pp 661-674 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Radiation hazards to astronauts during space flights from heavy galactic particles in cosmic radiation are discussed in relation to the LET of the various particles. Data are presented on the energy spectrum of α particles, neutrons, protons, and charged particles of various elements as determined from measurements of particle tracks on photographic emulsion detectors exposed on high-altitude balloons and satellites. The mean free paths for nuclear interaction and attenuation in water by ionization were also calculated for a number of charged particles. The protective effects of space craft shielding are considered in relation to additional hazards during solar flares. (CH)

26099 LIFE SCIENCES AND SPACE RESEARCH XII. Proceedings of the Sixteenth Plenary Meeting of COSPAR and the Deutsche Forschungsgemeinschaft of the Federal Republic of Germany, Constance, Germany, May 23–June 5, 1973. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974). 243p. (CONF-7305107-). 65.- M.

Thirty-one papers presented at the meeting are included in four sections: exobiology, radiation biology, gravitational biology, and planetary quarantine. Separate abstracts were prepared for 11 papers. (MCG)

For abstracts of individual papers see: 26058, 26100, 26149–26151, 26192–26194, and 26611–26613.

26100 BIOSTACK EXPERIMENTS I AND II ABOARD APOLLO 16 AND 17. Buecker, H. (Univ., Frankfurt am Main). pp 43-50 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on life sciences and space research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

The concept of the Biostack experiment has become practicable through European scientific collaboration and with help of NASA. The objectives of this experiment flown aboard Apollo 16 and 17 are to study the biological effects of individual heavy cosmic particles of high-energy loss (HZE) not available on earth; to study the influence of additional space flight factors; to get some knowledge on the mechanism by which HZE particles damage biological materials; to get information on the spectrum of charge and energy of the cosmic ions in the spacecraft; to estimate the radiation hazards for man in space. For this purpose the Biostack experiment comprises a widespread spectrum of biological objects, and various radiobiological end-points are under investigation. Bacterial spores, protozoa cysts, plant seeds, shrimp eggs, and insect eggs were included in the Biostack experiment packages together with different physical radiation detectors (nuclear emulsions, plastics, AgCl crystals, and LiF thermoluminescence dosimeters). By using special arrangements of biological objects and physical track detectors, individual evaluation of tracks was obtained allowing the identification of each penetrating particle in relation to the possible biological effects on its path. The response of the different biological objects to space flight and HZE ions bombardment was of different degree, presumably depending on the ability of the organism to replace the cells damaged by a hit. The results help to estimate the radiation hazard for astronauts during space missions of long duration. (auth)

26101 DETERMINATION OF RADIATION LOADS IN ABDOMINAL ANGIOGRAPHY. Balode, G. Yu.; Gubatova, D. Ya.; Zlemets, P. V.; Nemiro, E. A. Med. Radiol.; 20: No. 2, 35-39(Feb 1975). (In Russian).

The distribution of the exposure dose on the irradiated body surface of 20 patients during abdominal angiography was deter-

mined. The results showed that the irradiation fields are very inhomogeneous and that therefore the input exposure dose in the center of the beam does not reflect the actual conditions. For determination of the comprehensive dosimetric characteristics of radiation, it is necessary to know the dose distribution in the individual organs and the integral dose absorbed by the whole body of the patient. The method of thermoluminescent dosimetry appears to be useful for the determination of such comprehensive data. (JSR)

26102 UNEVEN IRRADIATION IN TUMORS (ON PROTECTION OF NORMAL TISSUES). Aliev, B. M.; Gus'kova, A. K. (Inst. of Experimental and Clinical Oncology, Moscow). Med. Radiol.; 20: No. 2, 74-87(Feb 1975). (In Russian).

A review is presented of data obtained in recent years on the reaction of normal tissue to irradiation during the radiotherapy of tumors. The methods used for the protection of normal tissues are considered. An extensive bibliography is appended. (JSR)

26103 SIX YEARS' EXPERIENCE WITH INTERSTITIAL ^{192}Ir THERAPY IN SKIN CANCER. Sinistero, G. (Ospedale S. Lazzaro, Turin). Radiol. Med.; 60: No. 11, 987-991(Nov 1974). (In Italian).

The 162 interstitial ^{192}Ir treatments for skin cancer carried out in 6 years are discussed. An after-loading technique was employed. Practical and technical questions are examined. The results were satisfactory. (auth)

26104 USE OF ^{192}Ir IN AFTER-LOADING RADIOTHERAPY FOR CANCER OF THE CERVIX. Peracchia, G. (Ospedale Maggiore, Parma, Italy). Radiol. Med.; 60: No. 11, 976-986 (Nov 1974). (In Italian).

The theoretical and practical aspects of the employment of ^{192}Ir in after-loading endocavitary management of cervical cancer are compared with those of apparatus using ^{60}Co ("Cathetron") or ^{137}Cs ("Curietron" and "Cervitron"). It is shown that iridium has technical advantages and, more particularly, that it is cheaper. Its adoption is therefore recommended. (auth)

26105 INTRACAVITARY IRRADIATION OF CARCINOMA OF THE UTERUS WITH ^{137}Cs SOURCES. Preliminary Dosimetric Study Prior to Clinical Employment. Volterrani, F.; Dragoni, G.; Donati, G.; Rabbi, A.; Gervasio, A. (Istituto Nazionale Tumori, Milan). Radiol. Med.; 60: No. 11, 965-975(Nov 1974). (In Italian).

The technical aspects of the employment of an apparatus for intracavitary management of carcinoma of the uterus using cesium sources and an after-loading technique are discussed. The results of a dosimetric study of dose distribution using a computer program are presented. (auth)

26106 RECOVERY IN NORMAL AND MALIGNANT TISSUES. Withers, H. R. (Univ. of Texas, Houston). pp 1101-1116 of Advances in Radiation Research. Biology and Medicine. Vol III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

A model was developed to investigate dose-response relationships during recovery of normal and malignant tissues. Studies were conducted on reoxygenation, repopulation, repair of sublethal injury, and redistribution of the cellular age-density in tissues. It was concluded that there is little difference between the sublethal damage repair capacities of normal and malignant tissues but that other processes such as reoxygenation and repopulation may provide avenues for research into improved dose-fractionation schedules in clinical radiotherapy. (HLW)

26107 POSSIBILITY OF GETTING DATA USEFUL FOR RADIOTHERAPY FROM EXPERIMENTAL RADIOTHERAPY. Suit, H. D. (Univ. of Texas, Houston). pp 1117-1128 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Consideration is given to limitations in interpretation of response by a population of spontaneous or naturally occurring tumors to a standard and a test radiation dose fractionation schedule which employs a single dose level. Then a review of certain of the questions which are of current interest in radiation therapy which may be investigated with effect at the laboratory level are discussed. (auth)

26108 EFFECTS OF FRACTIONATION IN RADIOTHERAPY. Repopulation of Normal Tissues During Treatment. Wambersie, A.; Dutreix, J. (Univ., Louvain, Belgium). pp 1153-1165 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Present data concerning repopulation after irradiation are reviewed for skin and intestine. Repair mechanisms are discussed: cell cycle shortening, increase of proliferative population, cell migration. Quantitative data available from in vivo cloning techniques and from the study of gross skin reactions or intestinal death are compared. (auth)

26109 OXYGEN EFFECT AND REOXYGENATION IN RADIOTHERAPY. Thomlinson, R. H. (Medical Research Council, London). pp 1175-1185 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The principles of the oxygen effect and of reoxygenation affecting the response of tumors to a course of radiotherapy are well known, but the exact circumstances in which they affect the outcome of the irradiation of particular tumors are far from fully understood. The oxygenation of a tumor is of consequence under three conditions: firstly, that the tumor does contain some clonogenic cells which are protected from injury by a particular dose of radiation because they are hypoxic at the time at which it is given; secondly, that cells surviving the dose for this reason are able, subsequently to proliferate in the local environment or to be disseminated and form metastases; and thirdly, that they are present in the tumor in a higher proportion than in the normal tissue which is limiting the size of dose which may be given to the tumor. (auth)

26110 AUTOIMMUNE REACTIONS AFTER LOCAL IRRADIATION OF SOME NON-TUMOR AND TUMOR TISSUE IN MAN. Clifford, P.; Einhorn, J.; Einhorn, N.; Klein, G.; Packalen, T.; Walstam, R.; Wasserman, J. (Kenyatta National Hospital, Nairobi, Kenya). pp 1225-1231 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Studies on the effect of local irradiation on the autoimmune reactivity to the irradiated tissue are reviewed. Local irradiation seems often to enhance immunological reactions to the irradiated tissue. (auth)

26111 CAPILLARY MICROSCOPIC OBSERVATIONS ON THE SUPERFICIAL MINUTE VESSELS OF ATOMIC BOMB SURVIVORS, 1956 TO 1957. Tsuya, A. (Cancer Inst. Hospital, Tokyo); Wakano, Y.; Otake, M. pp 1325-1330 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Capillary morphological studies were conducted in 1956-57 at ABCC on superficial blood vessels to determine late somatic effects of irradiation on 435 subjects composed of A-bomb survivors and their controls. Significant differences were observed in the score assigned to morphological changes, being marked in proximally exposed group and those exposed to 100 rad or more under the age of 10 at the time of bomb. The level of significance was higher for labial and lingual mucosa than fingernail fold and bulbar conjunctiva. (auth)

26112 POSSIBLE RADIATION-INDUCED AGING AS MEASURED BY IMMUNOHEMATOLOGICAL CHANGES IN A MARSHALLESE POPULATION EXPOSED BY RADIOACTIVE FALLOUT. Conard, R. A. (Brookhaven National Lab., Upton, NY). pp 1395-1403 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Electrophoretic and immunodiffusion studies in the Marshallese population exposed to radioactive fallout 16 years previously showed reduced levels of gamma globulins and certain immunoglobulins which may indicate a radiation-induced aging effect. Loss of immunological capacity, however, has not been noted in the exposed population based on the incidence of severity of disease compared with the unexposed population. (auth)

26113 RETINOBLASTOMA: A MODIFICATION IN RADIATION THERAPY TECHNIQUE. Weiss, D. R. (Children's Hospital Medical Center, Boston); Cassady, J. R.; Petersen, R. Radiology; 114: No. 3, 705-708(Mar 1975).

Patients with retinoblastoma treated with a single lateral field often suffer multiple recurrences in the anterior portion of the retina. The authors believe that these marginal recurrences are

related to dose heterogeneity and that the entire retinal surface is at risk. In an attempt to treat the entire retinal surface and still protect the lens and anterior chamber, a conventional lateral field with the anterior beam edge at the equator of the globe is used with a second anterior field in which the central divergent lens block is hung in a pendulum fashion along the central axis. The shadow of the central block projects a diameter of 10 mm at the anterior corneal surface which well encompasses the lens. The fields are weighted 1:4.5 (anterior to lateral). (auth)

26114 RADIATION THERAPY OF CARDIAC AND PERICARDIAL METASTASES. Cham, W. C.; Freiman, A. H.; Carstens, P. H. B.; Chu, F. C. H. (Memorial Sloan-Kettering Cancer Center, New York). Radiology; 114: No. 3, 701-704(Mar 1975).

From 58th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (1 Dec 1972).

Cardiac metastasis should be strongly suspected in the cancer patient with sudden onset of unexplained tachycardia, arrhythmia, or congestive heart failure. Conduction defects and low voltage on electrocardiographic examination and an enlarged heart shadow on the chest film are virtually confirmatory. Thirty-eight such patients were treated through anterior and posterior opposing portals and received 2,500 to 3,500 rads in 3 to 4 weeks, except for 6 lymphoma and leukemia patients who were controlled with lower doses (1,500 to 2,000 rads in 1½ to 2 weeks). Primary sites and duration of improvement were as follows: breast (11/16 patients): 2 to 36 months; lung (2/7 patients): 1 to 9 months; lymphoma and leukemia (6/7 patients): 2 to 4 months; others (4/8 patients): 1 to 4 months. Overall, the clinical improvement rate was 60% with durations of 12 to 36 months. (auth)

26115 RESULTS OF POSTOPERATIVE MEGAVOLTAGE RADIOTHERAPY OF MALIGNANT SURFACE EPITHELIAL TUMORS OF THE OVARY. Hintz, B. L.; Fuks, Z.; Kempson, R. L.; Eltringham, J. R.; Zaloudek, C.; Williamson, T. J.; Bagshaw, M. A. (Stanford Univ., CA). Radiology; 114: No. 3, 695-700(Mar 1975).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (30 Nov. 1973).

The results of postoperative radiotherapy in 151 patients with malignant epithelial tumors of the ovary are presented. Actuarial survival at five years for patients in FIGO Stage 1 was 76%; in Stage II, 56%; Stage III, 16%; and Stage IV, 0%. Survival also varied with histopathological type, the best prognoses occurring in the serous (malignant) and endometrioid types (NED survival of 35% and 50%, totalling all stages, respectively). The presence of ascites or intraperitoneal surgical spillage did not adversely affect survival. The role of lymphangiography in staging is discussed. New approaches to diagnosis, staging and treatment are required for improving the prognosis of patients with ovarian carcinoma. (auth)

26116 ADJUVANT EFFECT OF LUCANTHONE (MIRACIL D) IN CLINICAL RADIATION THERAPY. Turner, S.; Bases, R.; Pearlman, A.; Nobler, M.; Kabakow, B. (Albert Einstein Coll. of Medicine, Bronx, NY). Radiology; 114: No. 3, 729-731(Mar 1975).

Clinical trials were undertaken to determine whether lucanthone (miracil D) affects radiation-induced regression in measurable pulmonary metastases and advanced squamous-cell oral and pharyngeal tumors. The time required for 50% tumor regression was decreased by approximately 50% in those patients who received lucanthone in addition to irradiation. These results indicate that lucanthone has a definite adjuvant effect when used together with irradiation. (auth)

Vertebrates

Refer also to abstract 26066.

26117 CELL MIGRATION IN THE INTESTINE OF INDIAN DESERT GERBIL (MERIONES HURRIANAE JERDON) AND ITS RELATIONSHIP WITH THE RADIOSENSITIVITY OF THE ANIMAL. Bhartiya, H. C.; Srivastava, P. N. (Univ. of Rajasthan, Jaipur, India). Experientia; 30: No. 12, 1397-1398(15 Dec 1974).

Following intraperitoneal injection of tritiated thymidine, gerbils were killed at intervals from 1 to 120 h. Pieces of jejunum were removed and prepared for autoradiography and microscopic study. Results showed that approximately 120 h were required for labeled cells to move from the crypts to the tips of the villi. Data from other investigators are used for a graph showing the relationship between transit time and LD_{50} values in various rodents. Rodents with longer transit time have longer survival time. (HLW)

26118 ENZYME INDUCTION IN THE LIVER OF MICE AFTER THE COMBINED ACTION OF X RAYS PLUS ACTINOMYCIN D AND PUROMYCIN. Streffer, C. (Univ of Freiburg). pp 261-270 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Whole-body irradiation and actinomycin D as well as puromycin were combined in dose ranges where no effect was observed on the hepatic induction of two enzymes by hydrocortisone in mice when these treatments were given alone. The combination of x rays and actinomycin D gave an appreciable decrease of the induction for both studied enzymes while x rays and puromycin affected this process only for one enzyme. There appears not to exist a unique mechanism with the DNA as the target for ionizing radiation to explain the observed effects. (auth)

26119 SOME CLINICAL ASPECTS OF RADIOSENSITIZATION. Hoshino, T. (Univ. of California, San Francisco). pp 271-276 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The most important requirement for clinical radiosensitization of tumors is choosing an agent that will enhance the radiosensitivity of the tumor, but not that of the normal adjacent tissue. Before this choice can be made, the anatomical or biological characteristics of this tumor, as well as the mechanism of sensitization and the physiological or biochemical characteristics of the agent must be considered. Bromouridine (5-bromo-2'-deoxyuridine) is used as an example in this discussion of these factors. (auth)

26120 RADIATION GENETICS, FOUNDATION AND PERSPECTIVES. Sobels, F. H. (Univ. of Leiden). pp 277-298 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The first part of the paper aims to convey an impression of the lines of thought that led to Muller's discovery in 1927 that radiation produces genetic effects. The second part of the paper reviews a number of recent advances in the field of radiation genetics, with emphasis on the induction of translocations in mouse spermatogonia by x radiation and their significance for the interpretation of dose-rate effects and genetic risk estimates in man. (auth)

26121 METHODS IN STUDIES OF RADIATION HAZARDS IN MAMMALS. Luening, K. G. (Univ. of Stockholm). pp 311-322 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Comparisons are made of the effects of radiation in consecutive generations of rat and mouse populations. It is concluded that productivity (weaned young) does not deteriorate after several generations of irradiation. To examine the hazards of irradiation other approaches must be found. (auth)

26122 MUTAGENESIS IN THE MOUSE AND ITS APPLICATION TO THE ESTIMATION OF THE GENETIC HAZARDS OF RADIATION. Russell, W. L. (Oak Ridge National Lab., TN). pp 323-334 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The principles of radiation mutagenesis that have been worked out for mouse spermatogonia and oocytes differ markedly from some of the conclusions reached from Drosophila spermatozoa, which were originally thought to be general principles of radiation genetics. (auth)

26123 ROLE OF RADIOTOXINS IN RADIATION DAMAGE TO A CELL. Kuzin, A. M. (Inst. of Biological Physics, Puschino, USSR). pp 431-444 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Possible contribution of radiotoxins formed in the irradiated tissue to cell death is discussed. It was concluded that the substances of the polyphenol nature easily giving active semiquinones and quinones (similar to natural mutagenes and growth inhibitors) play an important role in the damaging of an irradiated cell genome. (auth)

26124 THE EFFECT OF LOCAL IRRADIATION OF THE SKIN PROTECTED BY CALCIUM PANTOTHENATE. Ghircoiasiu, M.; Clichici, M.; Uray, Z. (Babes-Bolyai Univ., Cluj (Romania); Lyon-1 Univ., 69 (France)). Compt. Rend. Soc. Biol.; 167: No. 12, 1830-1833(1973). (In French).

Rats were given calcium pantothenate and their skin was locally irradiated. The effect of irradiation on glycogen, lactic acid, and cholesterol metabolism in the liver and skin was followed in protected and controlled rats. The administration of calcium pantothenate resulted in a decrease of skin cholesterol, whereas the aerobic amount of liver cholesterol remained the same and degradation of skin glucides was enhanced. Calcium pantothenate has a protective effect on liver. (FR)

26125 SOME ASPECTS OF THE RBE FOR FAST NEUTRONS. Field, S. B.; Hornsey, S. (Hammersmith Hospital, London). pp 511-519 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The RBE for different normal tissue endpoints is presented and shown to vary with size of dose, and with the differential amount and rate of intracellular repair of each tissue. RBE data has been used to estimate the equivalent doses of x rays used in a re-evaluation of the early therapeutic trial of fast neutrons. The possible advantages of fast neutrons in human therapy are illustrated by the results of experiments on animal normal and neoplastic tissues. (auth)

26126 EFFECTS OF 15 MeV NEUTRONS ON TUMORS AND NORMAL TISSUES IN EXPERIMENTAL ANIMALS. Broerse, J. J.; Barendsen, G. W.; van Putten, L. M. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 551-564 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The RBE values of 15-MeV neutrons and x radiation were compared in normal rodent tissues (mouse bone marrow, mouse intestine, rat skin) and mouse and rat sarcomas containing 10 to 20% hypoxic cells. It was concluded that the responses of tumors depend on the fraction of anoxic cells, the rate of reoxygenation, and the radiation dose. This dependence of tumor radiosensitivity was less for fast neutrons than for x rays. (CH)

26127 ACUTE EFFECTS OF 1-MeV FAST NEUTRONS ON THE HAEMATOPOIETIC TISSUES, INTESTINAL EPITHELIUM, AND GASTRIC EPITHELIUM IN MICE. Davids, J. A. G. (Reactor Centrum Nederland, Petten). pp 565-576 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Survival curves of hematopoietic stem cells and intestinal stem cells of mice exposed to either high-LET fast neutrons or x-rays were compared. With both types of radiation the hematopoietic stem-cell population is the most radiosensitive. The difference in RBE factors for bone-marrow and intestinal lethality is reducible to an equal RBE difference for the initial stem cell damage in the two tissues. The RBE factors for damage to the gastric and intestinal epithelia appear to be similar. (auth)

26128 LENS OPACITY IN MOUSE AFTER RADIATION EXPOSURE: ROLE OF (1) RADIATION QUALITY AND DOSE, AND (2) TISSUE OXYGENATION AND DOSE RATE. Bateman, J. L.; Bond, V. P. (Lahey Clinic Foundation, Boston). pp 587-598 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The 0.42-MeV neutron RBE was compared with x radiation for opacification of the normally hypoxic lens of mice and of oxygenated lens. The results showed a decrease in dose rate effect with decreasing oxygen concentration. (CH)

26129 CELL LOSS RATE IN EXPERIMENTAL TUMORS FOLLOWING 14 MeV NEUTRON IRRADIATION. In Vivo Experiments with Labeled Iododeoxyuridine. Porschen, W.; Feinendegen, L. E. (Kernforschungsanlage, Juelich, Ger.). pp 599-609 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Irradiation of a transplanted sarcoma in mice with fast neutrons at different times after pulse-labeling with ^{125}I-UdR allowed determination of cell loss rates from the tumor. The efficiency of tumor labeling with ^{125}I-UdR decreased with increasing tumor volume. This technique of in vivo measuring cell loss rates led to the recognition that labeled cells in S-phase are more radiosensitive than those labeled cells out of S-phase. (auth)

26130 CHEMICAL PROTECTION AGAINST NEUTRON IRRADIATION. Sverdlov, A. G.; Mosjuchin, A. S.; Pavlova, L. M.; Nikanorova, N. G.; Postnikov, L. N. (Ioffe Physico-Tech. Inst., Leningrad). pp 611-617 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Some sulphur compound radioprotectors (cystaphose, AET Br HBr, cystamine) protect mice against neutron radiation. Analysis of the lethality of protected and control animals showed that the prophylaxis of intestinal damage was the principal mechanism of animal protection against neutron radiation. Mexamine and ethyrone administration did not notably affect the survival of the animals. (auth)

26131 ROLE OF RADIO-PREVENTIVE SUBSTANCES IN THE CREATION OF BIOCHEMICAL RADIORESISTANCE BACKGROUND. Kudryashov, Yu. B.; Goncharenko, E. (Moscow State Univ.). pp 649-659 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The physiological effects of the radioprotective substances, histamine and seratonin, and of injected lipid radiotoxins were studied in γ-irradiated rats under varying levels of hypoxia. Possible explanations for the pharmacological effects of certain radioprotective compounds are discussed. (CH)

26132 SIGNIFICANCE OF "RESTING" CELL POPULATIONS FOR HEMATOPOIETIC REGENERATION AFTER IONIZING RADIATION OR APPLICATION OF RADIOMIMETIC SUBSTANCES. Fliedner, T. M.; Haas, R. J.; Blattmann, H. (Univ., Ulm, Ger.). pp 707-724 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Thymidine labeled with tritium was employed to identify morphologically cytokinetically resting cells of hematopoietic tissues of the rat. ^{3}H-TdR was administered before and for several weeks after birth to obtain 100% labeled animals. Two weeks after the last ^{3}H-TdR injection in hematopoietic tissues, reticular cells and a small fraction of lymphocytes were found to have a very slow turnover time. In bone marrow there was no evidence that any of the differentiated cells remain labelled, so that there appeared to be no feed-in of resting cells into differentiated cells under normal steady state conditions. In the lymphatic tissues morphologically similar cell types were detected to be labeled 2 weeks after the last ^{3}H-TdR injection. However, in lymph nodes there were in addition to those cell types large and medium sized lymphocytes found to be labeled even months afterwards, indicating a continuous influx from resting cells of this organ. Administration of x irradiation or radiomimetic agents allowed the identification of those resting cells that respond with proliferative activity after perturbation of hematopoietic cell renewal systems. The findings suggest that only the small fraction of resting bone marrow lymphocytes respond with proliferative activity indicated by the reduction of the labeling intensity and a parallel increase of their number. (auth)

26133 REGENERATION OF CELL RENEWAL SYSTEMS WITH PARTICULAR REFERENCE TO STEM CELL TRAFFIC. Patt, H. M. (Univ. of California, San Francisco). pp 725-739 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

In most cell renewal systems in mammals there is a restricted traffic of stem cells and regeneration of a radiation damaged part requires cells of local or proximate origin. A notable exception is the lympho-myeloid complex. Yet, even here, circulating stem cells are of questionable physiologic significance in the steady state. Although distant metastases can have an important function in the restoration of hematopoiesis, this is not always the case. Depending upon the circumstances of damage, marrow restitution can involve a hierarchy of stem-type cells. In respect to hematopoiesis per se, it seems necessary to con-

sider the possible role of a pre-stem cell ancestor to the marrow CFU resident in osseous tissue. (auth)

26134 RADIATION RESPONSE OF THE INTESTINAL EPITHELIUM. Cairnie, A. B. (Queen's Univ., Kingston). pp 741-752 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Data are reviewed from a number of studies on the radiation response of intestinal epithelial cells in mammals following exposures to various doses of x radiation. The effects of the cell phase during exposure on the radiosensitivity of crypt cells and their regenerative ability are discussed. (CH)

26135 RADIOSENSITIVITY OF INTESTINAL CRYPT CELLS IN RELATION TO LET, DOSE, DOSE-RATE, AND OXYGENATION. Hornsey, S. (Hammersmith Hospital, London). pp 753-760 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Cell survival curves were obtained from observations of clones arising in a denuded area of mouse intestinal epithelium after irradiation of an exteriorized loop of the jejunum with fast neutrons (D_0 110), and fast electrons at 6 kilorad/min (D_0 125 rad) and 500 rad/min (D_0 160 rad) in mice breathing O_2 during irradiation; in mice breathing nitrogen during irradiation with fast electrons at 15 kilorad/min (D_0, 306), and breathing air during irradiation with fast electrons at 6 kilorad/min (D_0, 268). The $LD_{50/5}$ doses for animals given whole-body irradiation under these various conditions fit on the extrapolated survival curves at the same survival level on all curves. (auth)

26136 QUANTITATIVE STUDIES OF CELL POPULATION KINETICS DURING THE ACUTE REACTION IN THE SMALL INTESTINE OF MICE FOLLOWING WHOLE-BODY IRRADIATION. Devik, F. (Rikshospitalet, Oslo). pp 761-769 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Studies on whole-body x-irradiated mice showed that the cells of an intestinal crypt may be regarded as a population that may be useful in model studies on the reaction of a rapidly proliferating cell population to x irradiation, as well as to cytotoxic agents. Quantitative data after whole-body x-irradiation may be considered compatible with exponential cell survival curves. (auth)

26137 EFFECTS OF SPLIT DOSE PARTIAL ABDOMINAL IRRADIATION ON S AND M CELLS IN THE MOUSE DUODENAL CRYPT EPITHELIUM. Lesher, J.; Lesher, S. (Allegheny General Hospital, Pittsburgh). pp 771-780 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

One hundred day old C57B1 mice were divided randomly into 5 experimental series and given 2 x-ray doses of 300 R each (total dose 600 R) separated by 6, 12, 24, 48, and 96 hours. The number of cells in S phase (LN/crypt) and M phase (MF/crypt) were determined at various times after the second dose following the injection of ^{3}HTdR for each of the 5 experimental groups. Qualitatively the changes following the second 300 R exposure are similar to single dose effect, namely an immediate blockage of cells in G_2 and G_1 leading to a reduction in number of cells in S and M followed by an overshoot of control levels and a gradual return to control values. Quantitatively there are significant differences in degree of change and time of occurrence. The evidence suggests that some of these differences are due to partial synchronization of cells as a result of the early accumulation of large numbers of cells in G_2 and G_1. This, due to the differences in phase sensitivity, affects the degree of damage and the rate of repair and recovery. When the interval between doses is extended, the proliferative population is gradually redistributed between G_1, S, G_2 and M becoming asynchronous. Early damage is repaired and the effect of the second dose then becomes similar qualitatively and quantitatively to a single 300 R dose. (auth)

26138 CELL POPULATION KINETICS IN INTESTINAL EPITHELIUM AFTER X-IRRADIATION IN NORMAL AND GERM FREE RATS. Galjaard, H.; van der Meer, W.; de Both, N. J. (Dept. Cell Biology, Rotterdam, Netherlands). pp 781-789 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The transit time of epithelial cells on intestinal villi in conventional rats is about 36 hours and in germ free animals about 48 hours; the transit time in the crypt cells (12 hours) shows no difference. Autoradiographic studies after ^{3}H-thymidine incorporation showed that after x-irradiation a temporary increase in the pool of proliferating cells occurs in the intestinal crypt starting in conventional rats between 36 to 48 hours and in germ free animals between 60 to 72 hours. (auth)

26139 SURVIVAL AND MUTATIONAL RESPONSE OF SPERMATOGONIA OF THE MOUSE IN RELATION TO A NEW CONCEPT OF SPERMATOGONIAL STEM-CELL RENEWAL. Oakberg, E. F. (Oak Ridge National Lab., TN). pp 791-803 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

A model of spermatogenesis in mice was developed on the basis of ^{3}H-thymidine tracer studies of seminiferous epithelium stem cell division and differentiation. The model was used in a study of the survival and mutational response of spermatogonia following exposure of mice to single 1000 R doses of x radiation or two 500 R doses 24 hours apart. (CH)

26140 CELL POPULATION KINETICS IN THE SEMINIFEROUS EPITHELIUM UNDER CONTINUOUS LOW DOSE RATE IRRADIATION. Fabrikant, J. I. (Johns Hopkins Univ., Baltimore). pp 805-813 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Under continuous γ irradiation, cell renewal during spermatogenesis in the mouse achieved a near-steady state of cell population at a dose rate of 1.8 rads/day or less for at least 15 weeks by limited mechanisms of compensatory cell proliferation. Changes in the patterns of spermatogonial cell population kinetics indicated there was some reserve of proliferative capacity, but the extent to which these changes were due to decreasing the T_c of a precursor subpopulation in the A cell compartment, or the bringing-in of a potentially proliferative dormant cell population, is not, as yet, clearly understood. (auth)

26141 CELL POPULATION KINETICS OF ERYTHROPOIETIC CELLS IN RESPONSE TO RADIATION. Blackett, N. M. (Inst. of Cancer Research, Sutton, Eng.). pp 815-823 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Data are reviewed from a number of studies on the response of erythropoietic cells to various doses of acute irradiation. In vitro studies of stem cell survival and proliferation are based on the number of discrete clones of cells in the spleen of mammals following transplantation of stem cells into heavily irradiated recipients. In vivo studies of erythropoietic cell kinetics are based on the response of hypertransfused animals to a standard dose of erythropoietin, as measured by determining the incorporation of ^{59}Fe into erythrocytes, following irradiation. Following acute irradiation it was found that the stem cell number is decreased for one or more days before recovery begins. The difficulty in measuring the survival of cells that have commenced differation before irradiation and do not die until after one or more cell divisions, by which time they have reached a later stage of maturation are discussed. (CH)

26142 DIFFERENTIATION OF HAEMOPOIETIC PRECURSOR CELLS DURING RECOVERY IN RADIATION DEPLETED ANIMALS. Lahiri, S. K. (Rotterdam Medical Faculty, Rotterdam, Netherlands). pp 825-834 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Cell transplantation and spleen colony formation were used to study the kinetics of growth of hematopoietic cells in irradiated mice. Before the hematopoietic colony forming cell population starts growing, it suffers a loss in number, at least partly by differentiation. During the rapid growth phase, there is more self-replication than differentiation. An overshoot, which occurs in the spleen but not in the femur, is followed by more differentiation than self-replication. (auth)

26143 PATTERNS OF RECOVERY AND REPOPULATION IN IRRADIATED SKIN. Denekamp, J. (Hammersmith Hospital, London). pp 835-844 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The patterns of repair and repopulation of epidermal cells are very similar both qualitatively and quantitatively when measured by gross skin reactions or an in vivo cloning technique. A dose increment of about 500 rads is needed in the first 8 hours to counteract repair of sublethal injury; over 2 to 3 weeks after irradiation, only 30 rads per day are needed to counteract repopulation. (auth)

26144 SOME STUDIES OF THE X-RAY EFFECTS ON RESTING HAIR CELL POPULATIONS. Griem, M. L.; Malkinson, F. D.; Marianovic, R.; Kessler, D. (Univ. of Chicago). pp 845-852 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Hair matrix cells, that keratinize to form hair shafts, provide a useful test system for response of mammals to ionizing radiation, since these cells have wide variations in their metabolism from states of complete proliferative inactivity to stages of extremely high mitotic activity. Methods used to measure the response of the resting stage of the hair cycle to ionizing radiation are described. Serine labeled with ^{3}H was used as a tracer in some of the methods. Results are reported from studies on the effects of various doses of x radiation on injury and recovery of non-proliferating telogen hair in mice. (CH)

26145 INTRODUCTORY REMARKS AND THE ROLE OF SULFHYDRYLS IN THE CELL CYCLE RESPONSE OF MAMMALIAN CELLS TO X RAYS. Sinclair, W. K. (Argonne National Lab., IL). pp 861-868 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Experiments in synchronized Chinese hamster cells with a sulfhydryl binding agent N-ethylmaleide (NEM) indicate selective sensitization mainly in the resistant late S period. This finding plus the results of additional studies in which the sensitization of NEM is counterbalanced by the protection afforded by cysteamine support the notion that free sulfhydryl, naturally occurring in the cell and varying during the cell cycle, plays an important role in the lethal response to x irradiation. (auth)

26146 RADIOSENSITIVITY OF NON-DIVIDING CELLS IN VIVO. Kember, N. F. (Royal Free Hospital, London). pp 969-974 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

In hypophysectomised rats the rate of cell division in x-irradiated cartilage can be reduced by a factor of 20. Under these conditions there may be some decrease in cell radiosensitivity but there is no detectable change in the ability of cells to recover between split doses. (auth)

26147 ADVANCES IN RADIATION RESEARCH. Biology and Medicine. Volume III. Conference Held at Evian, France, June 29–July 4, 1970. Duplan, J. F.; Chapiro, A. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1973). 1530p. (In English and French). (CONF-700610-P3(B and M)). $42.00.

Separate abstracts were prepared for the 49 papers presented in this volume of the proceedings. (ERB)

For abstracts of individual papers see: 26014, 26015, 26041–26046, 26060, 26064–26066, 26106–26112, 26148, 26157–26184, and 26191.

26148 RADIOBIOLOGICAL BASES OF RADIOTHERAPY. Tubiana, M. (Institut Gustave Roussy, Villejuif, France). pp 1097-1100 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973). (In French).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Some topics reviewed are as follows: comparisons of the effects of radiation on healthy and neoplastic tissues; differences in rate of repair of sublethal lesions; significance of anoxic cells during radiotherapy; reoxygenation during fractionated irradiation; interstitial irradiation; kinetics of proliferation of mammalian cells; difficulties in extrapolating experimental results to man; and importance of distinguishing between experimental and clinical data. Radiotherapeutic techniques have acquired such a degree of perfection and efficiency, owing to accumulated observations during treatment of hundreds of thousands of patients, that it is necessary to be very circumspect before introducing modifications suggested by experimental results or theoretical considerations. The maximum possibilities of radiotherapy should not be exploited in irradiating all tumors whatever their location or histological type. It is probable that hundreds of thousands of cancer deaths could be prevented each year if there were more thorough understanding of the facts. (HLW)

26149 CHEMICAL PROTECTION AGAINST RADIATION-INDUCED GENETIC DAMAGE DURING THE PERIOD OF AFTER-EFFECTS OF GRAVITY STRESS. Pomerantseva, M. D.; Antipov, V. V.; Vilkina, G. A.; Gugushvili, B. S. pp 15-20 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on life sciences and space research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

The protective effect of cystamine (150 mg kg^{-1}) against genetic damage induced by γ-radiation in germ cells of the CBA line of mice (at doses of 100, 300, and 600 R) was studied. Cystamine reduced the frequency of dominant lethal mutations in sperms, spermatids and spermatocytes. The amount of protection depended on the radiation dose. After cystamine the lethal effect of radiation on the whole organism was reduced 2 to 3 times. After transverse acceleration (15 g over 10 min) the protective effect of cystamine against dominant lethal mutations induced by radiation (300 r) decreased on the average by $\frac{1}{3}$. The action of transverse acceleration alone somewhat reduced the radiosensitivity of germ cells. The administration of the protector and acceleration did not affect the frequency of reciprocal translocations induced by radiation in spermatogonia. (auth)

26150 RETINAL CHANGE INDUCED IN THE PRIMATE (MACACA MULATTA) BY OXYGEN NUCLEI RADIATION. Bonney, C. H. (School of Aerospace Medicine, Brooks AFB, TX); Beckman, F. N.; Hunter, D. M. pp 31-42 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on life sciences and space research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

Retinas of primates (Macaca mulatta) were exposed to oxygen nuclei at the Bevatron, Berkeley, California. Color fundus photographs and fluorescein angiograms were taken of the retinas prior to irradiation and up to 5 weeks post exposure. Animals were sacrificed at post exposure intervals for histopathologic examination of the retinas. A series of animals were exposed to 200-kVp x-ray and examined on the same regime as the first series. The results showed a low rad equivalent dose for retinal damage as compared with the x-ray series, i.e., a high quality factor, and a marked compression of the latency between exposure and onset of the retinal pathology. (auth)

26151 RESPIRATORY GAS EXCHANGE AS AN INDICATOR OF CHANGED RADIORESISTANCE IN MAMMALS. Novak, L.; Misustova, J. (Inst. of Biophysics, Brno). pp 125-128 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on Life Sciences and Space Research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

The paper deals with the problem of detection of radio-protective effects during irradiation. The method used is based on the fact that the known effective pharmacological and chemical radioprotectives (aminoethylthiouronium bromide HBr (AET), cystamine, sodium fluoroacetate (FAc), 5-hydroxytryptamine (5-HT), 5-methoxytryptamine (5-MT) and others) interfere directly or indirectly with enzymatic steps in energy metabolism of the organism. In mammals they induce at the same time an increase of resistance against ionizing radiation and a decrease in the respiratory gas exchange expressed by a depressed oxygen consumption. In experiments carried out on male mice of the H strain and male rats of the Wistar strain it was found that animals respiring a hypoxic mixture (5 to 8% O_2, STPD), have a lower oxygen consumption during the period of increased radioresistance similar to that seen during the effect of radioprotective drugs. This finding is of practical importance as it enables one to evaluate quantitatively the effect of radioprotective measures (including the hypoxia) in individual experimental animals during the course of irradiation. (auth)

26152 RELATIVE BIOLOGICAL EFFICACY OF NEGATIVE π-MESONS. Preliminary Report. Yarmonenko, S. P.; Shmakova, N. L.; Vainson, A. A.; Fadeeva, T. A.; Mescherikova, V. V.;

Bulatova, G. V. (Inst. of Experimental and Clinical Oncology, Moscow). Med. Radiol.; 20: No. 2, 70-72(Feb 1975). (In Russian).

The relative biological effectiveness of negative π mesons was studied using two criteria: the induction of chromosome aberrations in the bone marrow cells of mice and the survival of HeLa cell cultures. The RBE, in comparison with γ radiation, was 1.5 to 1.8 for the chromosome aberrations. The protective effects of a magnetic field was tested using x radiation. The results showed that a protective effect, if it is present is no more than 10 to 15%. The RBE for cell suspensions in comparison with x rays was 1.6 to 1.8. The smaller value found for the RBE of negative π mesons in comparison with that of other workers was discussed. (JSR)

26153 EFFECT OF IONIZING RADIATION ON IONIC PERMEABILITY OF MITOCHONDRIAL MEMBRANES. Medvedev, B. L.; Evtodienko, Yu. V.; Kuzin, A. M. (Inst. of Biological Physics, Pushchino-on-Oka, USSR). Dokl. Akad. Nauk SSSR; 217: No. 2, 466-469(1974). (In Russian).

The effect of γ radiation at a dose of 1 kR on the active transport of Ca ions into mitochondria associated with the exit of H^+ and K^+ from the mitochondria was studied in white rats for 24 hrs after the irradiation. The results obtained indicate that after irradiation there is an increase of the calcium capacity of the mitochondria and a decrease of the calcium permeability of the mitochondrial membranes. An analysis led to the conclusion that the observed changes in membrane permeability were caused primarily by changes in the lipids within the membranes. (JSR)

26154 DOSE-CONCENTRATION RELATIONS OF AMINO-PROPYL-AMINOETHYLTHIOPHOSPHATE IN SINGLE AND FRACTIONATED IRRADIATION. Vygodskaya, A. L.; Komarova, L. E.; Yarmonenko, S. P. (Inst. of Experimental and Clinical Oncology, Moscow). Med. Radiol.; 20: No. 2, 66-68(Feb 1975). (In Russian).

The dose-concentration relations of amino-propyl-aminoethyl-thiophosphate was studied in mice exposed to ^{137}Cs γ radiation in single doses up to 1150 R and in fractionated doses of 5 fractions at 300 R and in 4 fractions at 400 R. The results showed that in the single dose there is a clear dependence between dose and with increase of the dose it is necessary to increase the quantity of the protective substance in order to obtain the same effectiveness. In fractionated doses ¼ and even ⅛ of the quantity necessary for effective protection in single doses is effective. (JSR)

26155 EFFECT OF COSMIC MICROWAVE AND GAMMA IRRADIATION ON HEMATOPOIESIS. Tikhonchuk, V. S. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 3, 439-442(1974).

Translated from Kosm. Issled.; 12: No. 3, 478-482(1974).

With preliminary irradiation of mice with a microwave field having a total useful power of 100 mW/cm² for 4 min per day for a month (31 microwave irradiations) and a subsequent radiation load in a dose of 400 R (^{60}Co, 23 R/min) the radiation reaction is aggravated. The effect of the biological interaction of electromagnetic waves and ionizing radiation on the hematopoietic system obtained was evaluated as synergetic. (auth)

26156 CHANGES IN THE GREATER OMENTUM OF MICE OF DIFFERENT STRAINS AFTER INTRAPERITONEAL IMMUNIZATION WITH SHEEP ERYTHROCYTES. II. Study of the Capability of the Milky Spot Cells to Reconstitute the Humoral-Type Immunologic Response in Lethally Irradiated Mice. Szaniawska, B. (Skiodowska-Curie Inst. of Oncology, Warsaw). Arch. Immunol. Ther. Exp.; 23: No. 1, 11-17(1975).

Mice irradiated with lethal dose of x rays (900 R) received intravenous injections of the suspensions of syngeneic lymphoid cells isolated from milky spots of the greater omentum, spleen, and thymus. After two immunizations with sheep erythrocytes, on the 9th day following irradiation the spleen index, number of lymphoid nodules, and number of PFC in the whole spleen were determined. Suspensions of milky spot cells failed to influence the parameters under study in the irradiated animals compared with control group, which received the antigen only. On the other hand, injections of equal numbers of cells isolated from the spleen resulted in an increase of spleen index, appearance of several lymphoid nodules as well as PFC production in the spleens of these animals. The cells isolated from the milky spots, like spleen cells, injected concurrently with a large dose of thymic cells cooperate in the reconstitution of immunologic response in lethally irradiated mice. Results of this study prove that cell suspensions from the omental milky spots of mice can not restore the immunologic response to sheep erythrocytes. This deficiency can be most likely explained by the absence of thymus-dependent (T) lymphocytes in these cell suspensions. (auth)

26157 INTRODUCTION: HAEMOPOIETIC STEM CELL DIFFERENTIATION AND RECOVERY OF THE IMMUNE SYSTEM. van Bekkum, D. W. (Radiobiological Inst., Rijswijk, Netherlands). pp 999-1007 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The hematopoietic stem cell is an antigen sensitive cell and its response is the initiation of cell division. Their role in the recovery of the immune system in supralethally irradiated mice is discussed. (auth)

26158 ROLE OF CELL INTERACTIONS IN THE RECOVERY OF THE IMMUNE RESPONSE IN IRRADIATED MICE. Miller, J. F. A. P. (Walter and Eliza Hall Inst. of Medical Research, Melbourne). pp 1009-1021 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Interaction between antigen, thymus-derived and non-thymus-derived antibody-forming cell precursors has been demonstrated in the immune response of thymectomized irradiated mice. Antibody production, in some cases, can occur in the absence of thymus-derived cells, but recovery of antibody-forming capacity following irradiation is markedly impaired. Cell collaboration may thus be regarded as a mechanism serving to amplify the antibody response and to accelerate its recovery after irradiation. (auth)

26159 ROLE OF THE THYMUS IN IMMUNE RECOVERY IN LETHALLY IRRADIATED MICE PROTECTED WITH SYNGENEIC MARROW CELLS. Gregory, C. J.; Lajtha, L. G. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 1023-1031 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Kinetic studies of the recovery of anti-Srbc responsiveness in the spleens of lethally irradiated mice protected with a graft of million syngeneic marrow cells suggest that PFC precursor recovery precedes the reappearance in the spleen of thymus-derived auxiliary cells, although both of these cell populations recover much later than other populations of the hemopoietic system. (auth)

26160 RADIATION INDUCED DISSOCIATION OF IMMUNE RESPONSIVENESS IN THE RABBIT: DELINEATION OF A THYMUS-DERIVED AND A NON-THYMUS-DERIVED LYMPHOID CELL SYSTEM. Nieuwenhuis, P.; Veldman, J. E.; van den Broek, A. A.; Keuning, F. J. (Groningen State Univ., Netherlands). pp 1033-1045 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

A description is given of a thymus-derived and a non-thymus-derived lymphoid cell system associated with cellular and humoral immunity respectively. Light- and electron-microscopical observations on both types of immune responses in selected systems are presented. The non-thymus-derived lymphoid cell system is defined as comprising all lymphoid follicles and the role of germinal centers as a possible source of virginal immunologically competent cells is discussed. (auth)

26161 CELLULAR BASIS OF IMMUNOLOGIC RECOVERY OF LOCALLY IRRADIATED SPLEEN. Simic, M. M. (Inst. for Biological Research, Belgrade). pp 1047-1058 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Some cellular and cytokinetic aspects of immunologic recovery of a heavily irradiated peripheral lymphoid organ have been studied by means of a model system involving as basic procedure irradiation of the exposed spleen with 10,000 R of x rays. (auth)

26162 IMMUNOLOGICAL STATUS OF SYNGENEIC RADIATION CHIMAERAS AND THEIR SPLEEN CELLS. Stankovic, V.; Siljepcevic, M.; Hrsak, I. (Institut Rudjer Boskovic, Zagreb). pp 1059-1065 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Mice lethally irradiated and treated with syngeneic bone marrow are afterwards deprived of graft-versus-host reactivity in their spleens. Deprivation was permanent in CBA mice, although some others immune functions more or less restored with time. In C57BL mice syngeneic bone marrow confer the restoration of

spleens GVH activity in about one month. An explanation of the observed difference, based on the failure of CBA bone marrow to elicit graft v. host effects in F1 hybrid mice on manifestations of g.v. host activity that in hybrid recipients produce C57BL bone marrow is put forward. (auth)

26163 RADIOSENSITIVITY OF THE STIMULATED AND NON-STIMULATED ANTIBODY FORMING SYSTEM. Zaalberg, O. B.; van der Meul, V. A. (National Defense Research Organization, Rijswijk, Netherlands). pp 1067-1075 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The effect of x-radiation on the plaque forming capacity against sheep erythrocytes of the mouse spleen was investigated. The radiation effect at a certain dose was not constant but dependent on the time of radiation in relation to the time of antigen injection. A significant difference in radiation effect was observed between mice injected with antigen 24 hours after irradiation and mice injected within 1 hour after irradiation. In addition it was observed that the dose response curve in these two situations showed significant differences. The possible mechanisms responsible for these effects are discussed. (auth)

26164 RADIATION-INDUCED SUPPRESSION OF PRIMARY AND SECONDARY RESPONSES INITIATED AND MAINTAINED IN VITRO. Tao, T. W. (Harvard Univ., Boston). pp 1077-1084 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Lymph nodes from normal and immunized adult rabbits were cultivated in vitro for 3 to 4 weeks and antibody responses to ϕX 174 were initiated in these cultures. The responses included a primary type response with predominantly 19S antibodies, early memory responses with simultaneous induction of 19S and 7S antibodies and late memory response with primarily 7S antibodies. Irradiation dose ranging from 50 to 1000 rads given 1 day before to 1 day after antigen depressed both primary and secondary responses. No recovery from radiation injury nor radiation-induced enhancement was ever observed in this in vitro system. (auth)

26165 ROLE OF THE GUT IN THE METABOLISM OF IgA IN NORMAL AND LETHALLY-IRRADIATED MICE. Bazin, H. (Univ., Louvain, Belgium). pp 1085-1096 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The selective fall in IgA levels in irradiated mice is the combined result of two causes: x-ray damage to the intestinal epithelium, which is no longer able to retain the IgA synthesized in the gut wall within the boundaries of the body, and the very short half-life of this protein, which makes such rechannelling of the enterogenic IgA production doubly detrimental to the pool of circulating IgA. Further studies will show whether similar phenomena exist in other animal species. (auth)

26166 FACTORS INFLUENCING CHANGES IN TUMOR SIZE AFTER IRRADIATION. Pageau, R. (Centre Hospitalier Universitaire de Sherbrooke, Quebec). pp 1145-1151 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

In spite of a tremendous efficiency of dose fractionation in terms of cell inactivation, regrowth can still occur within 10 days after the first fraction is given. This may be explained by the recovery undertaken by cells between each fraction. Even if more cells are inactivated, the survivors are less damaged and they can divide more efficiently, in the sense that fewer cells die during mitosis. It was shown also that the cell cycle time of regrowing tumours is shorter than that of non-treated tumours of the same size. But in spite of the same growth fraction, the doubling time of those tumours is more than twice that of the unirradiated controls. It can be concluded then that an important cell loss is taking place not only during the tumour regression following irradiation but also during the subsequent regrowth. (auth)

26167 CELL POPULATION KINETIC ANALYSIS OF RADIOBIOLOGICAL DATA. Cohen, L. (Univ. of the Witwatersrand, Johannesburg). pp 1167-1173 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Cell population kinetic parameters derived by computer analysis of published data on whole body radiation lethality in mice and the response of the C_3H mouse carcinoma irradiated in situ, were found to be compatible with values derived by direct experiment, thus providing a measure of confidence in the kinetic model and computer program. (auth)

26168 RELATIONSHIP BETWEEN REGRESSION AND REOXYGENATION DURING FRACTIONATED IRRADIATION OF C3H MOUSE MAMMARY TUMORS. Howes, A. E. (M. D. Anderson Hospital and Tumor Inst., Houston, TX). pp 1187-1194 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Previous studies of transplanted mouse mammary tumors have shown that improvements in the oxygenation, and hence radiosensitivity, of previously hypoxic cells can be obtained by irradiating the tumors with either a single or a fractionated dose of 1500 rads of 250 kv x rays. However, before knowledge of this sort can be applied to suggesting improved methods of fractionation in clinical radiotherapy, an understanding of mechanisms which control the reoxygenation process is needed. A detailed account of the major processes which are probably involved has been described by Thomlinson and include: 1) tumor shrinkage, 2) changes in tumor oxygen consumption, and 3) changes in vascularization and blood supply. The relative importance of either of these processes is also unknown but it is generally agreed that tumor shrinkage accompanied by improvements in blood flow should give rise to significant improvements in oxygenation. In this paper, an attempt is made to elucidate the role played by tumor volume in the reoxygenation of hypoxic cells in transplanted mouse mammary tumors. Experimental results from two different systems will be considered. It is concluded that, in the systems studied, differences in the gross response of tumors to fractionated radiation exist due, largely, to variations in rates of population. The differences in repopulation are reflected in relative changes in the volumes of the tumors, rapidly proliferating cells giving rise to progressively growing tumors in the experiments described here. Differences in the amounts of reoxygenation between the two groups are relatively slight and probably insignificant so that many of the new cells produced by repopulation are either hypoxic or very quickly become transferred to a hypoxic environment. Consequently, the progressing tumors will contain a larger absolute number of hypoxic cells than those which regress and will therefore be relatively more radioresistant. (ERB)

26169 OXYGENATION AND REOXYGENATION OF A MOUSE MAMMARY CARCINOMA. Kallman, R. F. (Stanford Univ., CA). pp 1195-1204 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Approximately 18 to 21% of the cells of a mammary carcinoma of BALB/c mice were severely hypoxic in tumors with average diameters of 5 to 9 mm, as determined by quantitative cell transplantation. A single dose of 1000 rads preferentially killed the tumors' oxygenated cells, and reoxygenation proceeded to completion with 6 hours. (auth)

26170 EXPERIMENTAL DIFFICULTY IN THE MEASUREMENT OF REOXYGENATION. Hill, R. P.; Bush, R. S. (Ontario Cancer Inst., Toronto). pp 1205-1213 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Results indicate that in the tumour investigated, changes in the slopes of the survival curves do not present serious limitations to the measurement of the hypoxic fraction. In this tumour 6 hrs or less would seem to be the optimum time to give a second dose of radiation. (auth)

26171 DOSE-DEPENDENT AND DOSE-INDEPENDENT FACTORS IN TUMOR RADIATION RESPONSE IN VIVO. Maruyama, Y. (Univ. of Minnesota, Minneapolis). pp 1233-1243 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

To deal with large populations of tumor cells, therapeutic agents are effective in destroying the reproductive capacity of large numbers of cells. To effect tumor cure requires the destruc-

tion or restraint of all tumor cells. Dose-dependent and dose-independent factors in tumor cell radiation response are reviewed for a syngeneic mouse lymphoma. The importance of host-resistance complements that of the therapeutic agent by coping with the few surviving tumor cells. (auth.)

26172 RADIATION AND VIRUS INTERACTIONS IN MURINE LEUKEMIA INDUCTION. Kaplan, H. S. (Stanford Univ., CA). pp 1289-1301 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

A family of RNA viruses, apparently ubiquitous in mice and probably also in other animal species, appear to be the universal causative agents of the lymphomas and leukemias in these species. In most murine strains, such viruses are latent and apparently innocuous throughout life, unless animals are exposed to radiation or certain chemicals which, by "activating" the virus and simultaneously injuring the thymus, bone marrow, and immune system, trigger the initiation by the virus of the leukemogenic induction process. (auth)

26173 LATE EFFECTS OF RADIATION AND THEIR RELATIONSHIP TO SUPPORTING TISSUES. Lindop, P. J. (St. Bartholomew's Hospital, London). pp 1303-1313 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The effect of single doses of radiation on acute and late effects in the mouse are compared in an attempt to find either a unifying initial lesion, target cell or tissue; or a predictive relationship between acute and a longterm effect. The tissues studied are the bone marrow stem cell population in relation to 30 day lethality, lifeshortening and leukaemia induction; structural and functional changes in the irradiated kidney; and factors affecting the acute and late structural and functional changes in the microcirculatory arterioles of the irradiated ear lobe in the mouse. (auth)

26174 SOME ASPECTS OF THE EFFECTS OF RADIATION ON THE VASCULAR SYSTEM. Reinhold, H. S. (Radiobiological Inst., Rijswijk, Netherlands). pp 1315-1324 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The effects of ionizing radiation on the vascular system are discussed. Special emphasis is given to damage to the endothelial lining and effects on vascular permeability. These findings are significant in view of the fact that vascular damage may become dose-limiting in the case of fractionated radiotherapy. (ERB)

26175 ULTRASTRUCTURE OF LUNG PARENCHYMA AND PERMEABILITY CHANGES OF THE BLOOD AIR BARRIER AFTER A LOCAL EXPOSURE OF MICE TO 2000 R OF X-RAYS. Maisin, J. R.; Oledzka-Slotwinska, H.; Lambiet-Collier, M. (CEN, Mol, Belgium). pp 1347-1360 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Mice were exposed to 2000 R of x rays to the whole chest or to the right hemithorax. At various periods from 0 to 15 months after exposure, the changes in the ultrastructure of the lung and the transport of HRP was examined by electron microscopy. (auth)

26176 SUMMARY OF THE FIRST PART OF THE SYMPOSIUM: MICROANATOMY OF SUPPORTING TISSUES AND IMMUNE MECHANISMS. Hollander, C. F. (Inst. for Experimental Gerontology, Rijswijk, Netherlands). pp 1361-1365 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

This part of the symposium brought clearly forward that one of the primary endpoints which will have to be studied intensively is the quantitative and qualitative aspect of damage to the endothelial cells. Suggestive evidence has been brought forward of impairment of function of the endothelial lining of the vessel. Furthermore, the secondary effects of these changes on the other part of the vessel wall should be investigated, as well as late consequences of the irradiation of the properties of the interstitium, which may be helpful to elucidate the mechanism of late fibrosis. In development of these lesions, attention should also be given to the role of the underlying ageing process. (auth)

26177 ROLE OF THE MICROBIAL ENVIRONMENT IN RADIATION-INDUCED LIFE SHORTENING AND ITS RELATION TO HOST-DEFENSE SYSTEMS. Walburg, H. E. Jr. (Oak Ridge National Lab., TN). pp 1367-1380 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

It has been demonstrated that although host-defence systems of GF mice reflect their understimulated state by decreased serum globulins and functional cells, the capacity to respond to a proper stimulus is unimpaired. In fact, data suggest a capacity for superior response in GF mice, perhaps because of absence of competing stimuli. The mean survival time of irradiated and unirradiated GF mice is greater than that of their CONV counterparts without greatly exceeding the maximum longevity generally associated with CONV mice of the same strain. In our experiments to date, most of the life shortening effects of radiation can be explained on the basis of induction of specific diseases—lymphomas, myeloid leukemia, glomerulosclerosis-associated with the host-defence systems. The delayed onset of neoplastic and nonneoplastic diseases of GF mice that account for their increased mean survival time may be associated with an increased or decreased capacity of the host-defence systems. It is also possible that the microbial environment influences these diseases by increasing cell turnover and thus increasing the number of cells susceptible to neoplastic transformation. (auth)

26178 LATE EFFECTS OF IRRADIATION ON IMMUNE RESPONSIVENESS OF AGING MICE. Jaroslow, B. N.; Miller, M. M. (Argonne National Lab., IL). pp 1381-1393 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Immunologic responsiveness, measured by the number of antibody-forming cells produced against sheep red blood cells, decreases with age to give $t\frac{1}{2}$ for 19S PFC ~9 months and $t\frac{1}{2}$ for 7S PFC ~6 months. When immunization is initiated in spleen cell cultures, the $t\frac{1}{2}$ is 6 months. A low dose of neutrons (150 rads) resulted in a marked loss of responsiveness 580 days after irradiation, whereas a comparable dose of ^{60}Co γ-radiation (206 rads), did not. Post-radiation recovery from 730 to 1000 rads of ^{60}Co γ-radiation did not exceed 60% of normal 2 years after exposure. (auth)

26179 CONSIDERATION OF AN IMMUNE FACTOR IN THE PATHOGENESIS OF RADIATION INDUCED PROGRESSIVE INTERCAPILLARY GLOMERULOSCLEROSIS. Guttman, P. H. (Univ. of California, San Francisco). pp 1405-1415 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Progressive intercapillary glomerulosclerosis is an age-associated lesion in mice, rats, hamsters, and dogs. Sublethal irradiation causes an acceleration and increase in the severity of the lesion in laboratory animals, and this effect is more marked in young than in old animals. Direct exposure of the kidney is necessary for potentiation of IGS. A latent period precedes the onset of IGS, and the length of this latent period is related to age at the time of irradiation. An immune factor has been demonstrated in the pathogenesis of age-associated and radiation-induced IGS. The results of current studies on kidneys of survivors of the atomic bomb in Hiroshima are summarized. (auth)

26180 LATE EFFECTS OF RADIATION ON THE IMMUNE SYSTEM: A SUMMARY. Makinodan, T. (Oak Ridge National Lab., TN). pp 1417-1424 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The differentiation pathways of immunocompetent cells before and after antigen exposure, the immediate effects of radiation on the immune system of adults, and the age-dependent changes in the activity of the immune system are briefly reviewed in order to provide better insight into the cellular and, hopefully, molecular levels of the complex problem of late radiation effects on the immune system. Discussions of previous authors in the conference on late effects are briefly reviewed. (ERB)

26181 DOSE DEPENDENCE FOR LIFE SHORTENING BY X-RAYS, GAMMA RAYS, AND FAST NEUTRONS. Sacher, G. A. (Argonne National Lab., IL). pp 1425-1432 of Advances in Radia-

tion Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The effectiveness per Roentgen of gamma rays for shortening life of mice increases as the first power of the daily dose from about 24 to 170 R/day and is constant at higher or lower daily doses. The high-dose constant is about 0.0030 R^{-1} and the low-dose constant about 0.00043 R^{-1}. (auth)

26182 RADIATION INJURY EFFECTS ON MINERAL METABOLISM IN SHEEP AND CATTLE. Bell, M. C.; Sasser, L. B.; Wade, L. (UT-AEC Agricultural Research Lab., Oak Ridge, TN). pp 1471-1476 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Beta radiation injury to the gastrointestinal tract increased erythrocytic ^{65}Zn uptake more than anorexia alone. Beta irradiation of the skin increased ^{65}Zn erythrocytic uptake after a period of 8 weeks. The radioisotope procedure was more sensitive to radiation changes than stable zinc analyses. Gastrointestinal irradiation reduced plasma Ca and Mg while skin irradiation reduced plasma Fe. Both sources of beta radiation increased plasma Cu. Gamma irradiation produced no measurable effect on the minerals studied in sheep and cattle. (auth)

26183 RADIOBIOLOGY AT THE CELLULAR LEVEL. Whitmore, G. F. (Ontario Cancer Inst., Toronto). pp 1489-1502 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

The papers discussing cellular radiobiology that were presented during this conference are briefly reviewed. From these papers, the author concludes that three major aims are operative: investigation of the nature of radiation damage within the cells; the use of radiation as a tool to investigate normal processes within cells and even more importantly within tissues; and to gain insights which will make possible a much better use of radiation as a therapeutic tool. (ERB)

26184 PROGRESS AND PROSPECTS IN MAMMALIAN RADIOBIOLOGY. Mole, R. H. (Medical Research Council, Harwell, Eng.). pp 1503-1510 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

A brief selective survey of the papers dealing with mammalian radiobiology at this conference is presented. It is the author's opinion that the increase in understanding in the field of mammalian radiobiology, though real, is quite modest. (ERB)

26185 EXPERIMENTAL MANIPULATION OF PRELEUKEMIC CHANGE IN WHOLE-BODY IRRADIATED RFM/UP MICE. Ludwig, F. C.; Morat, M. M.; Schug, W. G. (Univ. of California, Irvine). Proc. Soc. Exp. Biol. Med.; 148: No. 2, 375-379(Feb 1975).

Radiation which induces leukemogenesis in the unirradiated mouse, inhibits leukemogenesis if given again to the previously irradiated, but not yet leukemic mouse. The objective of this experiment was to identify nonmalignant late radiation injury in the bone marrow, the modification of which by a second exposure may account for postponement of radiogenic leukemia. To this end, leukemogenically irradiated RFM/Up mice were reirradiated under conditions known to bring about postponement of the leukemias due to the first radiation exposure. Quantitative analysis of the femoral bone marrow of these mice shows that leukemia incidence is positively correlated with the number of immature myeloid cells, and negatively correlated with the percentage of the mature myeloid cells in the entire myeloid series. The implications of this for the understanding of preleukemic change are discussed. (auth)

Invertebrates

26186 NON-RANDOMNESS IN THE INDUCTION OF MUTATIONS AND THEIR ELIMINATION IN DROSOPHILA. Falk, R. (Hebrew Univ. of Jerusalem). pp 299-310 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress and radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Lethal mutant induction in Drosophila in response to the dose of x radiation received was investigated. Of a sample of 35 lethals induced by x rays, 30 were shown to involve more than one functional unit. Recessive lethals in the X chromosome of Drosophila were screened in two short segments of the chromosome. (CH)

26187 CONTAMINATION OF ARENICOLA MARINA L. BY CAESIUM 137 IN TERMS OF SEXUAL MATURITY AND SEX. Amiard-Triquet, C. (Nantes Univ., 44 (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service de Recherches Toxicologiques et Ecologiques). Ann. Inst. Oceanogr.; 50: No. 1, 67-70(1974). (In French).

Contamination of the coelomic fluid was stronger during the reproduction stage than during sexual rest, radiocaesium being concentrated by the genital products found in the coelomic fluid. The contamination of the spermatozoids was higher than that of the ovules. Concentration of ^{137}Cs in the other organs was not affected by sexual maturity. (FR)

26188 EFFECTS OF ACCELERATED PARTICLES ON THE AGING OF DROSOPHILIA. Atlan, H. (Ames Research Center, Moffett Field, CA); Welch, G.; Miquel, J. pp 689-700 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973). (In French).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The biological effects of charged α particles were compared with the effects of ^{60}Co γ radiation in Drosophila. Survival time and indications of accelerated aging were the biological parameters studied in relation to radiation dose. (CH)

26189 HABROBRACON IN THE BIOSATELLITE EXPERIMENT. von Borstell, R. C. (Oak Ridge National Lab., TN); Smith, R. H.; Whiting, A. R.; Grosch, D. S. pp 701-705 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

Numerous genetic and physiological parameters were assayed in Habrobracon after they had been exposed to cosmic radiation and the space vehicle environment for two days during orbital flight. Most effects from the flight were small or nonexistent. Some large effects (e.g., recessive lethal mutations) could be attributed to vibrations associated with launch; two large effects (enhancement of fecundity and hatchability in oogonia) could be attributed to weightlessness. (auth)

26190 ALTERED RECOVERY IN NON-CYCLING BONE MARROW STEM CELLS. Hanks, G. E. (Univ. of North Carolina, Chapel Hill). pp 975-979 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

High specific activity tritiated thymidine suicide and Vinblastine experiments demonstrated that the colony-forming unit (CFU) compartment of mouse bone marrow contains a group of cells that do not undergo mitosis or DNA synthesis in a 24 hour period. These non-cycling CFU may play a particularly important role in re-populating bone marrow after depletion with cycle-active chemotherapeutic agents, and the existence of this compartment has partially provided the basis for logical programs of cyclic chemotherapeutic administration. The radiation single-dose response curve of this non-cycling CFU compartment was shown to have a D_0 similar to CFU as a whole, but no shoulder on the dose response curve. The effects of split doses of x radiation are reported. (CH)

26191 RADIATION INDUCED STERILITY IN INSECTS FOR THE CONTROL AND/OR ERADICATION OF AGRICULTURAL PESTS. LaChance, L. E. (IAEA, Vienna). pp 1463-1470 of Advances in Radiation Research. Biology and Medicine. Vol. III. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P3(B and M).

Some potential applications of the sterile insect release method are considered. Originally conceived for screwworm control, and later applied to fruit flies, the possible future application to other species is discussed. Research and calculations in the determination of the optimum sterilization dose and the effects of releasing fully sterile or partially sterile insects are presented. (auth)

26192 INTERACTION BETWEEN RADIATION EFFECTS, GRAVITY, AND OTHER ENVIRONMENTAL FACTORS IN TRIBOLIUM CONFUSUM. Yang, C. H.; Tobias, C. A. (Univ. of California, Berkeley). pp 21-30 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on life sciences and space research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

Multicellular organisms possess homeostatic control systems, which, in responding to changes of the external environment, modify the internal milieu of the organism accordingly, in order to make survival and normal physiological processes possible. This group has studied effects on physiological processes of single and combined environmental factors in the flour beetle, Tribolium confusum. Studies included low- and high-LET radiation, gravity compensation, near-weightlessness in space flight, ambient temperature, atmospheric composition, and magnetic field effects on the growth and development of Tribolium. For somatic effects, there appears to be a "normal physiological range" for each of these environmental variables; moreover, their effects seem independent of each other. When one of the listed environmental factors is near the limits of normal physiological tolerance, however, marked synergism has been observed between the effects of this factor and other environmental stresses. Fertilized Tribolium eggs showed a differential radiosensitivity to external irradiation, and a linear, dose-effect relationship was obtained, as accelerated heavy nitrogen and oxygen ions were used. Synergism was found when Tribolium were irradiated with ionizing radiation and subsequently exposed to temperature either below or above their normal physiological range. Gravity compensation or near-weightlessness in space flight have adverse effects on the development of Tribolium when an ambient temperature is near the higher or lower limit of tolerance. Similar results were observed when pupae were exposed to a combination of oxygen, temperature and magnetic field stresses. (auth)

26193 PRELIMINARY RESULTS ON THE ACTION OF COSMIC HEAVY IONS ON THE DEVELOPMENT OF EGGS OF ARTEMIA SALINA. Ruether, W. (Marburg Univ., Ger.); Graul, E. H.; Heinrich, W.; Allkofer, O. C.; Kaiser, R.; Cueer, P. pp 69-74 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on life sciences and space research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

The Biostack experiment aboard Apollo 16 contained one unit with eggs of the brine shrimp Artemia salina. The eggs were fixed in polyvinyl alcohol foils. Nuclear emulsions and plastics were used as track detectors. The development of 260 eggs hit by cosmic heavy ions was investigated. It differed significantly from the development of the flight controls—eggs flown in the Biostack but not hit by heavy ions—and of the ground controls. From these results it was concluded that a hit of a single heavy ion may injure the encysted blastula. This damage was found to influence the gastrula formation and even the hatching process of the nauplius. Abnormalities of the orthonauplius were observed during the development of the hit eggs. These are shortened extremities, or abnormal thorax or abdomen. In addition, in the Biostack II aboard Apollo 17 eggs of Tribolium confusum and Carausius morosus were included. The influence of single heavy ions on the development process of these highly organized insects was investigated. (auth)

26194 STUDY OF COSMIC RAY EFFECTS ON ARTEMIA SALINA EGGS DURING THE APOLLO 16 AND 17 FLIGHTS. Planel, H. (Laboratoire de Biologie Medicale, Toulouse); Soleihavoup, J. P.; Blanquet, Y.; Kaiser, R. pp 85-89 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on life sciences and space research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

Artemia salina eggs, embedded in polyvinyl alcohol, were used to study the biological effects of heavy ions of cosmic rays. Each biological layer was sandwiched between track detectors. Hit eggs by heavy ions show a great inhibition of their developmental ability. A lower inhibition is observed for eggs that were flown but not hit. Simulation experiments are in progress to determine the factors responsible for inhibition of eggs that were not hit and to improve our knowledge of cellular damage induced by heavy ions. (auth)

26195 ATTRACTANTS FOR THE SCREWWORM: IRRADIATION EFFECTS ON BACTERIA-INOCULATED MEDIA. Eddy, G. W.; DeVaney, J. A.; Handke, B. D.; Lopez, E. Ann. Entomol. Soc. Amer.; 68: No. 2, 269-270(Mar 1975).

A dose of ca. 2000 krad was required to kill bacteria in media prepared from homogenized 3rd-instar screwworm larvae, Cochliomyia hominivorax (Coquerel), and in sterile whole and defibrinated blood. The production of substances attractive to screwworm flies was reduced when the media were irradiated at 2000 krad in ^{60}Co gamma source. However, blood irradiated at 20 krad then inoculated and incubated was more attractive than unirradiated and incubated blood. (auth)

Radionuclide Effects (Internal Source)

Refer also to abstract 25996.

Man

Refer also to abstracts 25764, 25767, 26076–26084, and 26201.

26196 EFFECT OF THE WORKING ENVIRONMENT ON THE METABOLISM OF RED BLOOD CELLS OF MINERS IN DEEP URANIUM MINES. Pehr, F. (Ustav Hygieny Prace v Uranovem Prumyslu, Pribram (Czechoslovakia)). Ind. At. Spatiales; 18: No. 3, 17-32(May 1974). (In English, French).

Changes in the red cell metabolism from venous blood of miners from uranium mines, which developed as a consequence of the working hazard, were investigated. On the examples of the methaemoglobin reduction test and the methaemoglobin level attention is drawn to deviations inside the red cells. The relationship between the rate of methaemoglobin reduction and the number of years underground was expressed by a grade 3 parabola with the maximum after 4.6 years of work in the mines. A similar relationship, which was almost the mirror image of the former relationship, was observed in the blood methaemoglobin level, with the minimum after 3.6 years in the mines. The haemoglobin content bound in the red cell membrane and the cholinesterase activity of stromas provided evidence of alteration of the red cell membranes. The relationship between the haemoglobin content in the stromas and the number of years underground could be expressed by two grade-two parabolic branches with the point of intersection after 5.5 years work in the mines. The cholinesterase activity first declined briskly and then had a mildly descendent trend. It was possible to express the relationship by a hyperbola of general shape $(ax + b)/(cx + d)$. (FR)

26197 INDUCED ACTIVITY AND CERTAIN ASPECTS OF DOSIMETRY IN CALIFORNIUM-252 INTRACAVITARY APPLICATIONS. Nagarajan, P. S.; Gopalakrishnan, A. K.; Raghavendran, C. P.; Iyer, P. S. (Bhabha Atomic Research Centre, Bombay (India). Div. of Radiological Protection). Strahlentherapie; 148: No. 4, 366-374(Oct 1974).

The potential use of californium-252, which is a source of fission neutrons and gamma rays, in interstitial implants and intracavitary applications in radiation therapy is being studied in many centers. Radiobiological investigations of this source are also being pursued. Various elements in bone and soft tissue get activated mainly by the neutrons degraded to thermal energies within the body. The dose due to neutron capture events, that due to the radioisotopes induced, and their activities were computed. The maximum total activity consequent to a typical intracavitary application is estimated to be nearly 2 microcuries; this is mainly due to Na-24, P-32, K-42 and Ca-45. The capture contribution to dose in the pelvic bone is found to be nearly 14% of the fast neutron dose. The beta-gamma decay doses in both bone and tissue are negligible. (auth)

Animals

Refer also to abstract 26009.

26198 BIOLOGICAL EFFECTS OF TRANSMUTATION AND DECAY OF INCORPORATED RADIOISOTOPES. Antoni, F.; Szabo, L. D.; Varteresz, V. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). pp 137-146 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610–P1(B and M).

The effect of the disintegration of ^{32}P incorporated into the nucleic acids was studied. It has been found that ^{32}P distintegrating intramolecularly in tRNAs derived from the liver of chick embryos may impair the amino acid acceptor activity. In the tRNAs studied the decrease in acceptor activity was the most marked in methionine-tRNA. Activity decrease was less and

less marked according to the following sequence: leucine-, phenylalanine-, histidine-, serine- and valine-tRNA and no decrease was found for lysine-tRNA. The impaired tRNA has been proved to exert mixed inhibition on the tRNA- and aminoacyl-tRNA synthetase enzyme reaction. It is suggested that tRNAs modified during the transmutation of ^{32}P may behave as structural analogues. (auth)

26199 CHEMICAL CONSEQUENCES OF NUCLEAR DEEXCITATION. Adloff, J. P. (Centre de Recherches Nucleaires, Strasbourg). pp 147-158 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973). (In French)

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

The effects of nuclear reactions during the transmutation of internally-deposited radioisotopes on the molecular structure of nucleic acids in biological materials are discussed. The difficulties encountered in measuring the contributions of ionization, excitation, photon emission, and energy levels due to the internal conversion of electrons to the decomposition of nucleic acids are illustrated using selected radioisotopes as examples. (CH)

26200 BIOLOGICAL TOXICITY OF IODINE-125, CONTRIBUTION FROM THE AUGER EFFECT. Ertl, H. H.; Feinendegen, L. E. (Kernforschungsanlage, Julich, Ger.). pp 169-179 of Advances in Radiation Research. Biology and Medicine. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P1(B and M).

Iodine-125, which elicits the Auger effect, is a valuable tracer for DNA, the precursor being 5-Iodo-Deoxyuridine (IUdR). The effects of intranuclear Iodine-125 (from IUdR) and of tritium (from thymidine) on the renewal of DNA measured by tracer dose of I^{131}-UdR in the whole mouse were compared. The experiments indicate that the effect of Iodine-125 exceeds that of tritium by a factor of 5 to 20, on the bases of decay events. On the bases of absorbed dose from the electrons emitted, only a three-fold increase of effect of Iodine-125 over tritium is expected. Since other damaging mechanisms, such as recoil or chemical transmutation, can be excluded in case of I^{125}, localized molecular fragmentation of the DNA as consequence of the Auger effect needs being evoked for interpretation. (auth)

26201 RESEARCH ON THE BIOLOGICAL EFFECTS OF ATMOSPHERIC POLLUTANTS. Lafuma, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section de Pathologie et Toxicologie Experimentale). Bull. Inform. Sci. Tech. (Paris); No. 191, 91-95(Apr 1974). (In French).

The real biological problem arising from atmospheric pollutants is the induction of lung cancer. Mention is also made of chronic secondary infections and of alveolar clearance troubles which aggravate the toxic effect of pollutants. The results of an experimental study on an animal subjected to a lung overcharged with the dust of various chemical substances (silica, coal, titanium oxide) are described. It is found that as the weight of dust increases, the clearance rate of the alveolus diminishes. A study was also made of the effect of radioactivity on alveolar clearance by subjecting animals to dust intakes of plutonium-239 nitrate. A phenomenon similar to that found for stable dusts is noticed. Finally as part of the research work on lung cancer induction by inhaled radioelements the conclusion is reached that the better the dispersion of an inhaled radioelement in the lung the greater is its toxicity and it is probably more cancer forming. Cancers of the lung induced in rats compare in every way with those observed in man subjected to conventional or radioactive pollutants. (FR)

26202 INHALED RADIOELEMENTS. Lafuma, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section de Pathologie et Toxicologie Experimentale). Radioprotection; 9: No. 1, 15-25(1974). (In French).

From Radiobiological seminar on internal contamination; Paris, France (18 Mar 1974).

The results described fall within the framework of long-term research aiming at studying the pathological effects of inhaled radioelements, namely plutonium-239 oxide, americium-241 nitrate and curium-244 nitrate. A DL = 50 value was determined for each radioelement and for each physical-chemical form. This DL = 50 rises from the curium-244 nitrate to the plutonium-239 oxide. The differences observed are linked to the number of cells affected, which depends on the degree of heterogeneity of radio element distribution. Many cancers were obtained during the experiments. These cancers had histological types identical to certain human cancers. Irrespective of the dose, the first animals to die showed metaplases, those living on had non-malignant tumours, and it is in those living the longest that cancers were found. This systematic succession of cellular damage foreshadows the possibility of interpreting the various different mechanisms entering into cancer induction. (FR)

Microorganisms

Refer also to abstracts 26007 and 26010.

Nuclide Kinetics and Toxicology

Man

26203 TRITIUM CONTAMINATION AND EXTRACORPOREAL DIALYSIS. Henry, P. (CEA Centre de Marcoule, 30-Bagnols-sur-Ceze (France)). Radioprotection; 9: No. 1, 41-83(1974). (In French).

From radiobiological seminar on internal contamination; Paris, France (18 Mar 1974).

When there is heavy internal tritium contamination, it becomes necessary to use a therapy to speed up the rate of water renewal in the system. The purpose of this work is to determine the efficiency of extracorporeal dialysis methods to hasten the elimination of tritiated water. The experimental results show that it is possible to lower the biological half-life in man to 13 hours by peritoneal dialysis and to less than 4 hours by hemodialysis. The choice of the nature and duration of the treatment must be based on the calculation of the dose involved; in actual practice there is hope of reducing this to 5^5 of its initial value. (FR)

26204 THE 133-XENON-CLEARANCE OF MUSCLES IN THE UPPER EXTREMITIES. Held, K.; Schreier, A. (Kiel Univ. (F. R. Germany). 1. Medizinische Klinik). Klin. Wochensch.; 52: No. 15, 728-735(Aug 1974). (In German).

Muscle blood flow (MBF) was determined by ^{133}Xe clearance at rest, during exercise and subsequent reactive hyperemia in 65 persons free of vascular symptoms. MBF decreased significantly with increasing age in the whole group and in males. No significant differences were found between males and females, or between the right and the left side. MBF was significantly higher on the upper arm than on the forearms whereas no differences existed between forearm and thumb. (auth)

26205 INTERNAL RADIO-CONTAMINATION THERAPY. Present Aspects and Future Prospects. Ducousso, R.; Pasquier, C. (Centre de Recherches du Service de Sante des Armees, 92-Clamart (France)); Nenot, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section de Pathologie et Toxicologie Experimentale). Radioprotection; 9: No. 1, 27-39(1974). (In French).

From radiobiological seminar on internal contamination; Paris, France (18 Mar 1974).

Therapeutic data evolution between the 50's and 60's is analysed by separating the contaminating radioelements into two categories: transferable elements and non-transferable elements. Current therapeutic data are then presented, stressing the concept of urgency valid for all contaminations by any radioelement and irrespective of the entrance door. DTPA, in particular, has enabled enormous progress to be made in the treatment of internal contamination in the last ten years. It is very efficient on ions of the most dangerous nuclides, plutonium and transplutonium elements, if administered immediately after the accident. In the case of insoluble oxides, the efficient action of the surgeons in the case of wounds and the development of lung washing in the case of inhalation permit efficient decontamination. (FR)

26206 MODELS OF LUNG RETENTION BASED ON ICRP TASK GROUP REPORT. Brain, J. D.; Valberg, P. A. (Harvard Univ., Boston). Arch. Environ. Health; 28: No. 1, 1-11(Jan 1974).

In aerosol exposures, it is important to determine the concentrations of deposited particles in the respiratory tract and correlate that with various factors describing the aerosol. Using a four-compartment lung model (with specified clearance times from each compartment), expressions were derived and Fortran IV programs written to calculate particle retentions. Three exposure patterns were considered: continuous chronic, acute pulse, and 40-hour work week exposures. Particle concentrations in each compartment at any time and integrated exposure over any period were calculated for each pattern. Results show that changes in particle size and solubility can alter retention and integrated exposure in some compartments by orders of magnitude, even when identical masses of aerosol are inspired. Thus, air quality standards must take size distribution and solubility of the particle into account. (auth)

Animals

26207 (CEA-R-4658) EXPERIMENTAL STUDY OF THE TRANSFER OF ^{60}Co BETWEEN A MARINE ANNELID AND ITS PREDATORS: THE CRAB CARCINUS MAENAS AND THE PLAICE PLEURONECTES PLATESSA. Amiard-Triquet, C.; Amiard, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Mar 1975. 48p. (In French). Dep. NTIS (US Sales Only) $5.50.

The absorption and urinary, bronchial, and fecal excretions of ^{60}Co resulting following the administration of contaminated food were followed in crabs and plaices between one and five months. Elimination following immersion of the animals in uncontaminated water was observed in the crabs and plaices for six and three months respectively. Assimilation rates of radiocobalt and stable cobalt as a carrier were different according to species: high in Carcinus, very low in Pleuronectes. Uptake of cobalt isotopes occurred mainly in crab hepatopancreas and in plaice liver and kidneys. On account of the high concentration of ^{60}Co in these organs, there may result for these species internal exposures highly localized but fairly strong and long-lasting as cobalt seems to be retained in a hardly exchangeable form. (FR)

26208 ^{35}S INCORPORATION IN NEURAL MEMBRANE PROTEIN INVOLVED IN PERIPLANETA AMERICANA CHEMORECEPTION. Singer, G.; Rozental, J. M.; Norris, D. M. (Univ. of Wisconsin, Madison). Experientia; 30: No. 12, 1384-1385(15 Dec 1974).

Sulfur-35-labeled L-cystine dihydrochloride was injected into the hemocoel of male cockroaches. Protein extraction was carried out at intervals from 1 h to 35 days later. Results confirmed the electrophoretic characteristics of the chemoreceptor protein and demonstrated selective ^{35}S incorporation into the membrane-bound receptor following injection of ^{35}S-cystine into the hemocoel. It is thought that the ^{35}S-labeled proteins that are precursors of the membrane-associated receptor contain thiol groups and bind messenger, but that these saline-soluble proteins lack the abilities of the membrane-bound T_1 receptor to change conformation in response to each messenger, as occurs in the energy-transferring mechanism in the sensory nerve membrane during chemoreception. (HLW)

26209 TRANSPORT OF ^{203}Pb AND ^{47}Ca FROM MOTHER TO OFFSPRING. Kostial, K.; Momcilovic, B. (Inst. for Medical Research and Occupational Health, Zagreb). Arch. Environ. Health; 29: No. 1, 28-30(Jul 1974).

The transfer of ^{203}Pb and ^{47}Ca from mother to fetuses and litter was examined 48 hours after a single intravenous application of both radioisotopes to rats on the 18th day of pregnancy and on the fourth and 15th day of lactation. The transplacental transport of lead was eight times lower than that of calcium while the transmammary transport of lead was four times lower. The highest transfer of both radioisotopes from mother to litter was observed during the late lactation period. (auth)

26210 EFFECT OF EFFERENT DUCT LIGATION ON THE UPTAKE OF ^{65}Zn BY THE EPIDIDYMIS AND VAS DEFERENS OF RHESUS MONKEYS (MACACA MULATTA). Roy, S. K.; Setty, B. S.; Chandra, H.; Kar, A. B. (Central Drug Research Inst., Lucknow, India). Acta Endocrinol.; 77: 186-192(1974).

The uptake of ^{65}Zn by different segments of the epididymis (caput, proximal corpus, distal corpus, and cauda) and vas deferens of rhesus monkeys was investigated. The vas showed maximum accumulation as compared to different parts of the epididymis. Ligation of the efferent ducts of the testis for 90 days resulted in the absence of sperms with a corresponding decrease in ^{65}Zn uptake in the epididymis and vas deferens. The latter, however, continued to show a relatively higher uptake than the epididymis. The significance of these findings is discussed. (auth)

26211 HIGHLY OXIDIZED CELLULOSES AS A MEANS OF PROPHYLAXIS IN EMERGENCY AID IN PERORAL ADMINISTRATION OF OSTEOTROPIC RADIONUCLIDES TO THE ORGANISM. Razumovskii, N. O.; Balabukha, V. S.; Torchinskaya, O. L.; Ivanov, V. I.; Kuznetsova, N. Ya. Med. Radiol.; 20: No. 2, 72-73(Feb 1975). (In Russian).

The highly oxidized cellulose, vokatsit, was tested for its prophylactic effects in rats and dogs after ingestion of ^{89}Sr, ^{90}Sr, ^{45}Ca, and ^{140}Ba. The results showed that vokatsit, introduced from 10 min to 1 hr after ingestion of the radioisotope, decreases the accumulation of the isotope in the bones. The introduction of the cellulose after incorporation of the isotopes into the bones has no effect. (JSR)

26212 THYROIDAL ^{131}I TURNOVER IN ADULT MALE RATS AT DIFFERENT TIMES OF THE SAME DAY. Jolin, T.; Tarin, M. J. (Centro de Investigaciones Biologicas, Madrid). Acta Endocrinol.; 77: 82-95(1974).

Male rats were fed a low iodine diet for 20 days. On the day of the experiment one group of animals was injected with ^{131}I at 8 a.m., while another group received the tracer at 6 p.m. Subgroups of animals then were sacrificed at different intervals. The low iodine diet induced hypertrophy and a low iodine content in the thyroid, and decreased the plasma PBI levels. The values of thyroid radioiodine uptake, percentual distribution of ^{131}I in thyroid hydrolysates, as well as the % plasma TCA precipitable ^{131}I and PB^{131}I, depended on whether the tracer was administered in the morning or in the afternoon, thus supporting the conclusion that the thyroidal ^{131}I metabolism is highest during the period of darkness. Moreover, experiments on normal rats have demonstrated that the renal clearance and excretion of urinary ^{131}I and ^{127}I is higher during the active than during the resting period. It is suggested that the diurnal change in thyroid activity may be induced by a relative body and thyroid iodide deficiency through an increase in the urinary loss of iodine. (auth)

26213 EFFECT OF EPINEPHRINE ON THE UPTAKE OF ^{131}I BY THE RAT THYROID, WITH PARTICULAR REFERENCE TO THE TRAPPING PROCESS. Joasoo, A.; Murray, I. P. C. (Prime of Wales Hospital, Randwick, Australia). CTa Endocrinol.; 77: 35-42(1974).

Epinephrine in doses of 1 to 200 μg/100 g body weight decreased the ^{131}I uptake by the rat thyroid gland in a dose-related manner. A minimal effect was observed as long as 16 h after the injection of 100 μg/100 g. The serum total ^{131}I level was initially higher in epinephrine-treated rats, showing that the decreased uptake was not secondary to an effect on extrathyroidal iodide metabolism. The trapping of ^{131}I was studied by measuring the thyroid serum ratio in rats in which organification of iodide has been blocked by propylthiouracil. The trapping of $^{99m}TcO_4^-$ was studied in rats with unblocked glands. Both ^{131}I and $^{99m}TcO_4^-$ trapping was decreased by epinephrine (100 μg/100 g sc) to approximately one half to one third of the control value for at least 1 h. It is concluded that the decrease in ^{131}I uptake can be at least partly attributed to decreased trapping, but the more prolonged decrease in ^{131}I uptake cannot be explained on the basis of present data. (auth)

New Tracer Techniques

Refer also to abstracts 25236, 25342, 25926, and 26117.

26214 (AE-489(Vol.1)) BONE MINERAL DETERMINATIONS. Proceedings of the Symposium held in Stockholm-Studsvik, Sweden, 27-29 May 1974. Vol. 1. Presented Papers. Schmeling, P. (ed.). (Aktiebolaget Atomenergi, Studsvik (Sweden)). Dec 1974. 166p. (CONF-740566-P1).

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

Separate abstracts were prepared for the 13 papers included. (MCG)

For abstracts of individual papers see: 25926 and 26215-26226.

26215 (AE-489(Vol.1), pp 6-26) QUANTITATIVE ANALYSIS OF CALCIUM IN THE SPINE USING X-RAYS OF DIFFERENT ENERGY QUALITIES. Krokowski, E. (Zentral-Roentgeninstitut mit Strahlenklinik am Stadtkrankenhaus, Kassel, Ger.). Dec 1974.

In bone mineral and determinations.

Pathological osteoporosis involves mainly the trumcus; it is therefore desirable to be able to determine the contents of calcium or hydroxylapatite in the spine quantitivly and very exactly. This was attained by the radiological substance analysis of bones using x rays of different energy qualities. A high degree of precision was reached using new electronic evaluation instruments. A number of significant clinical results were obtained concerning the grade and course of osteoporosis. Women are affected to a higher degree and earlier than men to the physiological decrease of calcium contents in the skeleton after the fourth decade. This physiological osteoporosis in females was often wrongly thought to be caused by a lack of oestrogens in climacterium and erroneously called postmenopause osteoporosis. A new theory of osteoporosis is proposed, in which the changes in bone marrow, intervertebral disks and muscles are considered as well as the decrease of bone substance. (auth)

26216 (AE-489(Vol.1), pp 27-36) MEASUREMENT OF THE CHANGES OF THE BONE MINERAL CONTENT BY EVALUATING THE CHANGES OF THE SPONGY STRUCTURE. Nagel, M. (Institut fuer Biomedizinische Technik, Stuttgart). Dec 1974.

In bone mineral and determinations.

The x-ray densitometric procedure is excellent in daily clinical work and is especially useful for detecting changes of the mineral

content above 10%. A new procedure attempts to detect smaller changes of the bone mineral content by observing the changes of the spongy structure. X rays of the calcaneus were used in the investigations. A photometer gives an electric signal proportional to the local density of the x-ray film. This signal is fed into the analog to digital converter of a small computer (PDP-12) and is classified using: various matched filters (inverse filter with additional Gaussian low pass filtering) or special cross correlation techniques (using fast Fourier transform algorithm and apropriate filtering in the frequency domain). The strong dependence of the photometric signals on the line of measurement is discussed. (auth)

26217 (AE-489(Vol.1), pp 37-50) DENSITOMETRIC RECONSTRUCTION OF BONE CROSS-SECTION. Nikolic, V.; Hudec, M.; Hudec, F.; Hancevic, J.; Mijatovic, Z. Dec 1974.

In bone mineral and determinations.

Changes in biomechanical conditions in the body result in the functional adaptation of the bone. The bone adapts to changed mechanical pressures by changing its shape, particularly the cross-section, and its internal structure and by effecting a redistribution of the material. The possibility of geometric and mathematical analysis of densitometric curves of the bone taken from different points for one and the same cross-section was investigated. A computer program was worked out, which, on the basis of densitogram data, produces approximate solutions for the shape of the bone cross-section and for the density distribution of bone matter within the cross-section. The densitogram was developed of an anatomical preparation of the femur from six different directions under conditions analogous to those in vivo. Verification of the method was performed by cutting out a 1 mm thick piece of bone at the point of the cross-section at which the measurement was made. The piece was then photographed by x rays and the x-ray picture was densitometrically analyzed. In view of the necessary geometric and mathematical approximations in the computing process, certain deviations from absolute values become unavoidable; however, this systematic error in the procedure does not affect the record of quantitative changes in periodic control of functional bone adaptation to changed conditions or in the control of healing of fractures. (auth)

26218 (AE-489(Vol.1), pp 51-57) LOSS OF CALCIUM DURING IMMOBILIZATION. Bohr, H. Dec 1974.

In bone mineral and determinations.

The excretion of calcium in the urine and the density of different bones in children with Coxa Plana were followed during treatment with prolonged bed rest. It was shown that the calcium output increased during the first two weeks to reach a maximal value of about 200 mg a day on the fourth week and then gradually decreased to reach normal values when mobilization was resumed. Densitometric determinations were performed through photometric measurements on x-ray photos of the hips, the heel bones and the wrists. The density of the normal femoral head decreased with about 20% at 3 months, and with about 30% at 6 months. The density of the heel bones decreased with 17 and 23% respectively at 3 and 6 months of immobilization, while at the wrists the bone density was only reduced with 4%. During the rest of immobilization the bone densities remained almost unchanged, but following mobilization the bone density again gradually increased to normal values. The loss of bone, which takes place during immobilization corresponding to the increased calcium excretion in the urine is probably most pronounced in bones such as the femoral head and the heel bone, with mainly cancellous structure and weight bearing function. (auth)

26219 (AE-489(Vol.1), pp 58-68) EFFECT OF THERAPY ON SEQUENTIAL BONE MEASUREMENTS IN OSTEOPOROSIS. Nordin, B. E. C.; Horsman, A.; Gallagher, J. C. (Medical Research Council, Leeds, Eng.). Dec 1974.

In bone mineral and determinations.

Sequential measurements of metacarpal cortical thickness show that pre-menopausal women as a group neither gain nor lose bone but that post-menopausal women (whether after artificial or natural menopause) lose approximately 1% per annum. Significantly reduced loss was observed on oestrogen therapy. There is no correlation between the rate of loss and dietary calcium in subjects on normal diets but the rate in those subjects on low calcium diets was significantly faster than in 12 subjects on calcium supplements. In post-menopausal women with spinal osteoporosis, the rate of bone loss is more than twice that of the controls. This rate of loss is significantly reduced by treatment with large doses of vitamin D. The effectiveness of vitamin D therapy is related to the effect of the therapy on calcium absorption. (auth)

26220 (AE-489(Vol.1), pp 69-82) NEW GAMMA SCATTERING TECHNIQUE FOR BONE DENSITY MEASUREMENTS. Olkkonen, H.; Karjalainen, P. (Univ. Central Hospital, Kuopio, Finland). Dec 1974.

In bone mineral and determinations.

A new gamma scattering technique for the determination of absolute bone density is introduced. The procedure involves the measurement of both transmitted and Compton scattered low energetic gamma rays in a narrow-beam geometry. The usefulness of both ^{99m}Tc and ^{170}Tm as a radiation source was studied. The method takes into consideration the change in the effective Z/A as a function of bone density, which is due to the changing of the elementary composition of bone when bone mineral is resorbed. The experimental results show that bone density can be measured with a reproducibility of ± 2% in the presence of arbitrary amounts of surrounding material. The density values for 26 distal radii show a good correlation with the results obtained by Archimedes' principle. (auth)

26221 (AE-489(Vol.1), pp 88-97) BONE MINERAL MEASUREMENTS IN THE CLINICAL SITUATION. Bevan, J. A. (Procter and Gamble Co., Cincinnati). Dec 1974.

In bone mineral and determinations.

The techniques of bone mineral measurement are discussed with reference to the clinical rather than the laboratory situation. The Norland Cameron Bone Mineral Analyzer was applied in a number of hospital settings for measurements in the arms and legs of both ambulatory and bedridden patients. The practical problems and limitations imposed by the patient's condition are described together with various mechanical devices and measurement strategies that have been designed to improve the precision and accuracy. (auth)

26222 (AE-489(Vol.1), pp 98-110) DENSITOMETRIC AND MECHANICAL PROPERTIES OF THE DISTAL RADIUS. Horsman, A.; Currey, J. D. (Medical Research Council, Leeds, Eng.). Dec 1974.

In bone mineral and determinations.

Densitometric and mechanical measurements were performed in vitro on 37 radii of Indian origin. The ash weight/unit length of each specimen at 6 sites was determined by the direct photon absorption technique. The bones were then cut 3 cm from the distal end and the distal segments subjected to compression tests. The peak load and work done on each specimen up to that point were measured. Highly significant relationships were found to exist between the weight/unit length in the distal radius and both the peak load and work done. A model of Colles' fracture causation and epidemiology is proposed based on the assumptions that the energy which must be dissipated in the distal radius while trying to break a fall is proportional to the weight x height product and that the energy which can be absorbed is dependent upon the ash weight/unit length at that site. (auth)

26223 (AE-489(Vol.1), pp 111-120) BONE MINERAL MASS EVALUATION USING TWO DIFFERENT COMMERCIAL SYSTEMS. Lindergard, B.; Lindholm, T.; Naversten, Y. (Univ. Hospital, Lund, Sweden). Dec 1974.

In bone mineral and determinations.

Two commercial systems, A and B, for evaluating bone mineral mass were studied. Both systems are based on photon absorption from mono-energetic radiation source (-s) which together with detector are scanned over the part of bone to be measured. System A is equipped with a ^{241}Am source, rate-meter and paper punch tape unit connected in series. Measurements are done on both forearms, 6 cm or 25% up on forearm from the ulnar styloid process. A computer program was worked out for calculations of bone width, mineral mass, and mean mineral mass. Special devices were constructed for accurate definition of measuring point and arm positioning during measurements. The technique A has been in use for about 2 years and about 3000 measurements are now done. System B is equipped with two radiation sources, ^{241}Am and ^{125}I. A built-in analog computing system makes it possible to do the measurements in free air. The scanner moves faster than in system A and usually five scans back and forth, 6.4 millimeters apart, are included in one measurement of a forearm. Mineral mass from one cut is obtained by subtracting the absorption from one nuclei from that of the other and then the mean from five cuts are calculated. The sensitivity was tested by measuring the same patient repeatedly on consecutive days and calculate the coefficient of variation. In about 50 patients the results from the two systems were correlated to each other in a linear way in 1:1 relation ($r = 0.97$). (auth)

26224 (AE-489(Vol.1), pp 121-135) BONE MINERAL ABSORPTIOMETRY OF THE FOREARM: NORMATIVE DATA. Nilsson, B. E.; Westlin, N. E. Dec 1974.

In bone mineral and determinations.

Data on bone mineral content in the forearm was collected in 300 healthy individuals, residents of the city of Malmö.

A commercially developed method of gamma absorptiometry was applied. The following variables are presented: bone mineral content (mg/cm^2), bone mineral content (mg/cm), and cortical thickness (mm). Age and sex patterns and absolute values are compared to data obtained by other investigators and with other methods. (auth)

26225 (AE-489(Vol.1), pp 136-154) METHOD FOR BONE MINERAL DETERMINATION INCLUDING A FLEXIBLE DATA HANDLING SYSTEM PROVEN IN CLINICAL ROUTINE. Schneider, U.; Banzer, D. Dec 1974.

In bone mineral and determinations.

A transmission-scanner (based on the method of Cameron and Sorensen) has been developed, which delivers additional information about structure and geometry of the bone by an integrated movable x-ray tube. The data are evaluated by a dialog-computer and are stored on a magnetic disc, together with clinical informations (patients data, diseases, medications etc.). Automatic reports for the physician are printed. Scientific evaluation is possible by several programs. Most of the human measurements were done on the calcaneus, normal ranges for this bone were evaluated. With a special equipment bones of small animals are measured. (auth)

26226 (AE-489(Vol.1), pp 155-166) ^{125}I POINT DETERMINATION OF BONE MINERAL CONTENT IN FINGER. Bjoerk, N. (Karolinska Institutet, Stockholm). Dec 1974.

In bone mineral and determinations.

A simple device for measurement of bone mineral in a phalanx is described. The attenuation of a narrow beam from ^{125}I and the thickness of the finger at the beam is measured. A radiogram with the position of the beam marked out can be obtained. 10 fingers from different individuals were measured in a cancellous part of the second phalanx near the joint during 6 months for evaluation of the repositioning error. (auth)

26227 (CEA-CONF-2601) ISOTOPIC CLEARANCE MEASUREMENT SYSTEM OF THE REGIONAL CEREBRAL BLOOD FLOW. Automatic Processing of the Results. Meric, P.; Guillier, F.; Grimont, B.; Mathis, S.; Leproux, G.; Seylaz, J.; Mamo, H.; de Cosnac, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). 19 Feb 1974. 17p. (In French). (CONF-740363-1; SES/PUB/SERF-74/35). Dep. NTIS (US Sales Only) $4.00.

From meetings on medical information; Toulouse, France (4 Mar 1974).

A system for measuring the regional cerebral blood flow, based on the measurement of intravenously injected ^{133}Xe by external counting of the photons emitted with detectors placed on the skull, is described. The system consists of a data acquisition system using a T 2000 minicomputer and data processing on the 360/91 computer. The models and algorithms used in the data processing are described and typical results are given. (JSR)

26228 (CONF-740132-(Absts.)) TUTORIAL SEMINAR ON OPTICS IN DIAGNOSTIC MEDICINE, JANUARY 9-11, 1974, TUCSON, ARIZONA. (Arizona Univ., Tucson (USA)). 1974. 60p.

From a tutorial seminar on optics in diagnostic medicine; Tucson, Arizona, USA (9 Jan 1974).

26229 (COO-3521-144) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Proposal No. 3. Metabolic Studies in Cancer with Radioactive Isotopes. Progress Report, May 1, 1973-October 31, 1974. Laughlin, J. S.; Myers, W. P. L. (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 31 Oct 1974. 120p. Dep. NTIS $9.00.

Progress is reported in the development of positron cameras for use in scanning patients following the administration of radiopharmaceuticals labeled with the cyclotron-produced short-lived positron emitters ^{13}N, ^{11}C, or ^{15}O. The preparation and preliminary testing of radiopharmaceuticals labeled with other cyclotron-produced short-lived radionuclides, including ^{52}Fe, ^{206}Bi, and ^{47}Ca, are described. A method is described for measuring whole- or partial-body Ca content in patients following neutron activation of Ca by exposure to cyclotron fast neutrons. A dual energy instrument was developed for use in photon absorption measurement of bone mineral content using ^{241}Am and ^{125}I as dual photon sources. (CH)

26230 STUDIES ON THE APPLICATION OF ^{125}I-LABELLED TESTOSTERONE IN PROTEIN BINDING METHODS. Wiedemann, M.; Wirtz, A.; Karl, H. J.; Raith, L. (Muenchen Univ. (F.R. Germany). 1. Medizinische Klinik). Z. Anal. Chem.; 272: No. 3, 195-198(Nov 1974). (In German).

From analytica 74th international salon of biochemical analysis and instrumentation and 1st European congress on clinical chemistry; Muenchen, F.R. Germany (22 Apr 1974). 2 figs.; 5 refs. Also issued as AED-CONF-74-146-004.

The newly synthesized ^{125}I-testosterone-3-carboxy-methyloxime-tyramide was tested for its applicability in protein binding methods. The binding of the radioactive steroid derivative to sex hormone binding globulin (SHBG), albumins, and testosterone antibodies was examined. The adsorption by florisil, charcoal, and amberlite was also studied. The results show that ^{125}I-testosterone is bound to antibodies obtained by immunization with testosterone-3-oxime-albumin conjugate similarly to ^{3}H-testosterone and unlabeled steroid. ^{125}I-testosterone and ^{3}H-testosterone show identical binding to florisil, charcoal and amberlite. Therefore the ^{125}I-labeled hormone is suitable in competitive protein binding methods using testosterone antibodies and it can displace the tritium labeled hormone. Since ^{125}I-steroids have higher specific activities the sensitivity of the method is increased. Furthermore the practicability is enhanced. Special problems arise through the relatively short half-life of the isotope and the changing specific activity. Another difficulty is the decreased chemical stability when compared with the tritiated steroid. (auth)

26231 HUMAN CALCITONIN RADIOIMMUNOASSAY IN NORMAL AND PATHOLOGICAL CONDITIONS. Heynen, G.; Franchimont, P. (Liege Univ. (Belgium). Inst. de Medecine). Eur. J. Clin. Invest.; 4: No. 3, 213-222(Jun 1974).

A radioimmunoassay for human calcitonin (CT) was established and each of its steps was analyzed in detail. The assay is extremely sensitive allowing the detection of 10 pg/ml in serum incubated in presence of human serum proteins using a standard curve. The specificity of the system was established on the basis of immunological and biological criteria. The method is sufficiently sensitive to allow the study of mechanisms of secretion of CT in normal man and in certain disease states. The secretion of CT is increased by induced hypercalcaemia and decreased by hypocalcaemia following EDTA. Elevated levels were found in patients with primary or secondary hyperparathyroidism or pernicious anaemia and in one patient with Zollinger-Ellison syndrome. The correlations between CT, serum calcium, phosphate, urea, magnesium, parathyroid hormone and gastrin were investigated. (auth)

26232 STUDY OF CELL PROLIFERATION OF THE HAIR FOLLICLE. Fry, R. J. M. (Argonne National Lab., IL); Weber, C. L.; Kisieleski, W. E.; Griem, M. L.; Malkinson, F. D. pp 853-860 of Advances in Radiation Research. Biology and Medicine. Vol. II. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 4th international congress of radiation research; Evian, France (29 Jun 1970). See CONF-700610-P2(B and M).

The hair follicle provides a suitable test system for a number of studies on cell proliferation, differentiation and intermittent growth. The latter characteristic makes it possible to study radiation effects in active and inactive proliferative cell populations. Plucking produces an injury which is suitable for the study of tissue response to injury as the response appears to be reproducible and similar in different animals and similar in some respects to spontaneously occurring intermittent growth. It is therefore possible to study the cell kinetics of the cell population during the repopulation phase after injury and compare this with the normal growth cycle. Results are reported from a study in mice of the growth induced by plucking and the suitability of squash preparations and combustion—liquid scintillation counting methods for such studies following the injection of ^{3}HTdR (0.5uCi/g, 0.36 Ci/mM) at 3, 6, 10, 16, 17, 18, 19 and 20 days and sacrifice at one hour later. (auth)

26233 SENSITIVE, RAPID, AND ECONOMIC RADIOIMMUNOASSAY OF HUMAN GROWTH HORMONE USING ETHANOL-AMMONIUM ACETATE. Saito, T.; Saxena, B. B. (Cornell Univ., New York). J. Lab. Clin. Med.; 85: No. 3, 497-504(Mar 1975).

An aqueous solution of 66 percent ethanol and 6.6 percent ammonium acetate has been used in the development of a relatively simpler and rapid, as well as highly reproducible, method of separation of antibody-bound and free hormones in the radioimmunoassay of human growth hormone (HGH). The present assay is sensitive to detect 20 pg. of hormone with a precision of ±5 per cent, hence, as little as 20 μl of plasma is required to perform the radioimmunoassay. Serum levels of HGH have been found to be approximately 70 percent of the plasma concentrations in the same subjects. (auth)

26234 EFFECT OF pH ON RADIOIMMUNOASSAY OF LH AND FSH. Nagata, Y.; Nakamura, R. M.; Osborn, C. E.; Naftolin, F.; Mishell, D. R. Jr. (Univ. of Southern California, Los Angeles). J. Lab. Clin. Med.; 85: No. 3, 515-522(Mar 1975).

Freezing and thawing of human serum produces alkaline changes in the pH. Weak buffers were of insufficient capacity to compensate for these pH changes. Thus the effect of serum pH on modified solid-phase and double-antibody radioimmunoassay (RIA) of LH and FSH was studied. Pooled postmenopausal serum standardized against the Second International Reference Preparation of Human Menopausal Urinary Gonadotropin was used as a laboratory standard. In the solid phase RIA for LH and FSH, slopes with the greatest maximum binding were obtained at pH 6.4, whereas for the double-antibody method best results were obtained at pH 8.0. Since there is individual variation in the pH of various serum samples, different values will be obtained from samples containing the same amount of hormone. It is suggested that the pH of serum samples be standardized by the use of buffers with the capacity to keep the pH of the serum constant and that serum standards be dialyzed. (auth)

26235 RADIONUCLIDE IMAGING IN INTRASCROTAL LESIONS. Datta, N. S.; Mishkin, F. S. (Martin Luther King, Jr., General Hospital, Los Angeles). J. Amer. Med. Ass.; 231: No. 10, 1060-1062(10 Mar 1975).

Twenty-three patients with a variety of intrascrotal lesions were studied by means of imaging after the intravenous injection of sodium pertechnetate Tc 99m. The features of the radionuclide image correlated well with the clinical course or findings at surgical exploration or both. The conditions in which this technique was helpful in diagnosis included testicular torsion, acute inflammatory lesions, abscess, and hematoma. (auth)

MATERIALS

26236 (TID/SNA-477) QUARTERLY PROGRESS REPORT, FIRST QUARTER CY 71. Project 187. Materials and Processing Development Activities, First Quarter 1971. Supplement, m001-1PR01-W234a2. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. 163p. Dep. NTIS $11.25.

Activities reported include: (1) Materials Properties Data book list to classify ductile and brittle behavior of materials; (2) property-data development reports that include toughness properties of aluminum alloy (AA) 7039-T63, tensile properties of seven candidate alloys, and thermophysical properties of AISI 347, AA 7039-T63, and Ti-5Al-2.5Sn ELI; (3) radiation damage effects from GTR-20C tests; (4) gaseous-hydrogen embrittlement of Ti-5Al-2.5Sn ELI; (5) improved statistical approach to developing design allowables for AA 7039 fracture toughness and fatigue; (6) planning of material test activities for CY 71 and beyond; and (7) simulated weld specimen of primary-injector L-channel configuration utilizing the metal-inert-gas short arc weld process. Component support topics include: (1) effect of simulated braze cycle on ARMCO 22-13-5 nozzle candidate material; (2) stress corrosion susceptibility of AA 7039-T63 pressure-vessel candidate material; (3) program to establish Category-A cyclic stress intensity (K_I) for prime TPA rotor material Ti-5Al-2.5Sn ELI; (4) impact tensile testing of Ti-5Al-2.5Sn ELI for valve and actuator applications; (5) filler-less orbital welding of AA 6061-T6 and AISI 347 tubing for line-use evaluation; (6) fabrication of three-dimensional woven-fiber graphite nozzle extension; and (7) creep and tensile testing of arc-cast and pressed-and-sintered tungsten alloyed with 25% rhenium in hydrogen at 3800 and 4000°F. (auth)

26237 (TID/SNA-1219) EFFECT OF RADIATION ON INSTRUMENTATION. Nilsson, D. A. (Aerojet-General Corp., Azusa, Calif. (USA)). Mar 1964. 20p. Dep. NTIS $4.00.

This is a bibliography of reports with radiation effects data on NERVA engine construction materials. (DLC)

26238 (TID/SNW-9) CATEGORY-C: MATERIALS DATA NUCLEAR SUBSYSTEM. E-105 Appendix. Volume V. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 281p. Dep. NTIS $17.25.

Data release memoranda are given for the mechanical and thermal properties of: TZM, 316 ss, 6061-T61 Al, pyrofoil, ZrC, ZrC-coated pyrofoil laminates, 302 ss, Armco iron, Hitron, silicon steel, SAE 9310, 440C stainless steel, irradiated Cu-24 vol% ^{10}B, and Durok. Some of the data relate to effects of irradiation or hydrogen. (DLC)

Ceramics and Cermets

Refer also to abstracts 25325, 25326, 26278, 26408, 28003, 28014, 28019, and 28746.

26239 (AGC-2275(Vol.4)(Pt.3)) MANUAL OF MATERIALS DATA RELEASE MEMORANDA, s131-DRM08-W187f4. Part III. DRM 24 through 45. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1971. 231p. Dep. NTIS $14.75.

Data on properties of Nerva reactor materials are presented. Information is included on Al_2O_3 coatings, Al, contaminant limits, Pb, composite materials, stainless steels, bronze, brass, LiH, Be-Cu alloys, invar, monel, and steels. (JRD)

26240 (JUL-1092-RW) NEW CONCEPTS CONCERNING THE DEPOSITION MECHANISM OF PYROCARBON. Luhleich, H.; Koizlik, K.; Pflaum, P.; Seeberger, D.; Linke, J.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). Aug 1974. 40p. (In German). INIS.

This study describes the present state of knowledge about pyrolysis reactions of gaseous hydrocarbons for coating processes and the deposition mechanism of pyrocarbon. After a discussion of previous model concepts of these processes and the contradictions involved, a new hypothesis is presented. This new concept can be characterized by the terms Langmuir zone, pyroaggregates, and carbon droplets. The new ideas are discussed in detail, and results of approximate experiments are presented. (GE)

26241 (ORO-4049-3) RADIATION DAMAGE IN OPTICALLY TRANSPARENT MATERIALS (ZIRCON). Progress Report, February 1, 1974-January 31, 1975. Thorpe, A. N.; Senftle, F. E.; Tsang, T.; Briggs, C. (Howard Univ., Washington, D. C. (USA)). 1975. Contract AT(40-1)-4049. 24p. Dep. NTIS $4.25.

The studies of the optical and magnetic properties of zircon reported previously were extended to synthetic doped zircons. Further magnetic susceptibility and EPR measurements were made on gem quality natural zircons. The EPR data on a few of the annealed natural specimens seems to indicate that ferric iron is formed during the natural radiation damage processes. At the present time the EPR data appears to be in agreement with the optical spectra data, but more experiments are necessary before direct correlations can be made between the optical and EPR measurements. From the new magnetic susceptibility information obtained on the Ytterbium and Erbium doped synthetic zircons, an initial analytical approach was proposed which appears to explain the apparently anomalous magnetic properties of natural zircon. The magnetic susceptibility measurements will have to be extended to include many more of the rare earth ions in zircons and related host crystals before a complete theory can be developed. (auth)

26242 (SAND-74-8012) THERMAL SHOCK RESISTANCE OF Al_2O_3 AND Al_2O_3/Nb CERMETS. Kramer, C. M. (Sandia Labs., Livermore, Calif. (USA)). Jan 1975. Contract AT(29-1)-789. 29p. Dep. NTIS $4.50.

Experiments were conducted to determine if ductile phase additions would improve the thermal shock resistance of brittle alumina ceramic. The addition of niobium to alumina was found to reduce the damage to specimens thermally shocked from 245°C to ambient in water. Certain aspects of material preparation and testing procedures affected the results of strength tests. (auth)

26243 X-RAY PHOTOELECTRON SPECTRA OF URANIUM AND URANIUM OXIDES. Correlation With the Half-life of ^{235m}U. Verbist, J.; Riga, J.; Pireaux, J. J.; Caudano, R. (Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium)). J. Electron Spectros. Relat. Phenomena; 4: No. 5, 193-205(Nov 1974).

From international conference on electron spectroscopy; Namur, Belgium (16 Apr 1974).

Uranium metal and the uranium oxides UO_2, U_3O_8, and UO_3 were studied by photoelectron spectroscopy. Chemical shifts of the 4f electronic core levels are measured, and the valence bands recorded. These data are correlated with measurements of the half-life T^h of ^{235m}U for the E3 isomeric transition by electron conversion. An attempt is made to explain the electronic structure in the valence region. (auth)

26244 CATALYTIC EFFECT OF PALLADIUM IN REDUCING MOLYBDENUM OXIDES. Uvarova, I. V. Izv. Akad. Nauk SSSR, Metal.; No. 4, 38-43(1974). (In Russian).

The production of a dispersed molybdenum powder by reduction with hydrogen is assured by a decrease in temperature at the stage of transition of molybdenum trioxide to the dioxide. The decrease in temperature at the beginning of MoO_3 reduction is attained by the use of a catalyst. The dispersion of the initial molybdenum trioxide has a slight effect on the dispersion of the final product. The dispersion of molybdenum powder depends directly on the dispersion of molybdenum dioxide. (SJR)

26245 STRUCTURE OF MELTED FERROUS OXIDE AND VANADIUM PENTOXIDE. Vatolin, N. A.; Lisin, V. L.; Pastukhov, E. A. (Inst. of Metallurgy, Sverdlovsk, USSR). Dokl. Akad. Nauk SSSR; 218: No. 3, 597-599(21 Sep 1974). (In Russian).

The structure of ferrous oxide ($Fe_{0.88}O$) in an Ar atmosphere and of V_2O_5 in air was studied at temperatures 10 to 20° above their melting points in a high-temperature x-ray chamber by reflection of x rays from the flat surface of the melt. The intensity of the reflected x radiation is shown graphically and compared with theoretical results obtained using different structural models. (JSR)

26246 DEFECTIVE STRUCTURE OF NON-STOICHIOMETRIC ZIRCONIUM DIOXIDE OF MONOCLINIC MODIFICATION. Vasil'eva, I. A.; Granovskaya, Zh. V.; Gerasimov, Ya. I. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 219: No. 4, 899-902(1 Dec 1974). (In Russian).

On the basis of the values of $\Delta\bar{G}_{O_2}^t$, $\Delta\bar{H}_{O_2}^t$, and $\Delta\bar{S}_{O_2}^t$ obtained in previous studies, a possible defective structure for ZrO_{2-x}^M, dependent on x, was proposed for the oxides in the region ZrO_2 to $ZrO_{1.981}$ in the temperature interval from 1173 to 1373°K. (JSR)

26247 PLASMA FREQUENCY OF V_2O_3. Shtorch-Shuker, P. (Hebrew Univ., Jerusalem). Phys. Status Solidi (a); 27: No. 2, 575-580(16 Feb 1975).

Measurements are reported of the reflectance and the temperature modulated reflectance spectra of V_2O_3 in the neighborhood of

1 eV. A strong peak at 0.95 eV in the thermoreflectance spectrum is assigned to the plasma frequency. A decrease of this frequency with temperature is observed. (auth)

26248 REACTION OF BERYLLIUM NITRIDE WITH TRANSITION METALS. Vasina, E. A.; Panov, A. S. Izv. Akad. Nauk SSSR, Metal.; No. 4, 204-206(1974). (In Russian).

In the region of 1200 to 1700°C the refractory metals (Mo, W, Ta, and Nb) react with beryllium nitride to form solid solutions and new compounds. Apparently the formation of solid solutions is a result of the dissolution of nitrogen in the refractory metals, and the phases that are formed are ternary compounds of the type Me_xBe_yN. The rate of reaction of refractory metals with Be_3N_2 is significantly lower than with Be and $ZrBe_{13}$. (SJR)

26249 PHASE EQUILIBRIA IN QUASIBINARY ALLOYS OF NIOBIUM–ZIRCONIUM NITRIDE. Ban'kovskii, O. I.; Gordeeva, T. I.; Moiseev, V. F.; Pechkovskii, E. P.; Trefilov, V. I. Izv. Akad. Nauk SSSR, Metal.; No. 4, 198-203(1974). (In Russian).

Equilibrium conditions are considered between a solid alpha-solution of the quasibinary alloys of Nb–ZrN and the nitride phase, and also gaseous nitrogen. Expressions were obtained for the concentration dependence of nitrogen in the solid solution of these alloys as a function of the temperature and partial pressure of nitrogen. It is shown that during vacuum thermal treatment it is possible to realize conditions leading to structural instability of two-phase alloys of niobium with zirconium nitride. In this case the concentration of nitrogen in the solid alpha-solution becomes substantially lower than the limiting solubility. Dissociation of the second phase and evolution of nitrogen from the alloy take place. (SJR)

26250 SOLUBILITY OF Ti, Zr, AND Hf NITRIDES IN VANADIUM. Barabash, O. M.; Shurin, A. K. Izv. Akad. Nauk SSSR, Metal.; No. 4, 194-197(1974). (In Russian).

A determination was made of the solubility of Ti, Zr, and Hf nitrides in vanadium, which decreases in the series TiN, ZrN, and HfN. An estimate was made of the mutual solubility of nitrogen and one of the IV A group of metals in vanadium at a constant temperature. Temperature and concentration dependencies of the equilibrium pressure of nitrogen over alloys of vanadium with metals of the IV A group were obtained. Alloys of vanadium containing titanium, zirconium, or hafnium nitrides are characterized by low values of the equilibrium pressure of nitrogen at high temperatures. This behavior indicates that these alloys are stable in vacuum. (SJR)

26251 NITROGEN DIFFUSION IN ZIRCONIUM NITRIDE. Desmaison, J. G.; Smeltzer, W. W. (McMaster Univ., Hamilton, Ont.). J. Electrochem. Soc.; 122: No. 3, 354-357(Mar 1975).

Diffusion of nitrogen in $ZnN_{0.93}$ plates (obtained by direct nitridation of 99.995 weight per cent zirconium sheets at 1150°C) was studied using the ^{15}N gas-solid exchange technique. These specimens were characterized by chemical analyses, density, lattice parameter, and structural measurements. The diffusion anneals were performed at a nitrogen pressure of 220 torr and at 1000 to 1200°C. The tracer diffusion coefficient can be expressed as $D^* (cm^2/sec) = 4.08 \times 10^{-6} \exp -36{,}600/RT$. These results, when compared to determinations of the chemical diffusion coefficients obtained from Zr nitriding kinetics, demonstrate that nitrogen transport in the polycrystalline solid at temperatures less than 1200°C is associated with a short circuit diffusion mechanism. (auth)

26252 OXIDE CHARGE AND SODIUM MOBILITY IN GAMMA-IRRADIATED SILICON DIOXIDE FILMS. Witherell, F. E. Jr. Bethlehem, PA; Lehigh Univ. (1974). 75p. University Microfilms Order No. 75-4744.

Thesis (Ph. D.).

A study has been made of the effects of gamma-irradiation and aluminum doping on sodium mobility in thermally grown silicon dioxide films on silicon. Aluminum can be diffused through 2000 Å silicon dioxide films in 30 minutes at 500°C. The aluminum content in the films near the $Si-SiO_2$ interface increases with increasing diffusion time. Moderate aluminum doping causes a decrease in interfacial sodium concentration, compared with undoped films. However, as the interfacial aluminum content increases with continued aluminum diffusion, interfacial sodium concentration increases again. These results suggest that aluminum is able to sequester sodium to those regions of the film where aluminum content is highest. Exposure of silicon dioxide films to gamma radiation results in positive oxide charge build-up, as measured by flatband voltage shifts in the capacitance-voltage characteristics of MOS capacitors. The interfacial sodium concentration does not increase significantly during this treatment. Irradiation followed by positive bias-temperature stress results in large increases in the interfacial sodium concentration for undoped and heavily aluminum doped oxides, but not for moderately aluminum-doped oxides. These results are consistent with a model in which sodium can be extracted from the $Si-SiO_2$ interface by substitutional aluminum impurities, resulting in reduced sodium mobility during irradiation and bias-temperature stress. (Diss. Abstr. Int., B)

26253 STUDY OF THE MECHANICAL BEHAVIOR OF POLYCRYSTALLINE ZIRCONIUM CARBIDE AND ZrC + B ALLOYS AT ELEVATED TEMPERATURES. Darolia, R. Seattle; Univ. of Washington (1974). 205p. University Microfilms Order No. 75-3966.

Thesis (Ph. D.).

The compressive deformation behavior of 100% dense polycrystalline zirconium carbide has been studied at various strain rates and temperatures in the range 1000 to 1800°C. Also, the deformation behavior of zirconium carbide alloyed with up to 3.0 wt% boron has been investigated. The rate controlling deformation mechanism has been identified by means of a study of the variation of the compressive yield stress with temperature. Thermally activated deformation parameters such as the activation energy, the activation volume, and the strain rate sensitivity have been calculated. Data on stress relaxation and strain recovery behavior for both ZrC and ZrC + B alloys are also presented. Serrated yielding has been observed and is discussed in terms of dynamic recrystallization. Nearly stoichiometric polycrystalline zirconium carbide (C/Zr = 0.945) and ZrC + B alloys with boron contents ranging from 0.25 to 3.0 wt% have been made by arc melting and subsequent homogenization in a graphite furnace. Specimens have been characterized by (i) chemical analysis, (ii) x-ray Debye-Scherrer method, and (iii) metallographic techniques. No yield drop was observed during compression testing at a strain rate of $3 \times 10^{-4} s^{-1}$ but was observed at strain rates of $3 \times 10^{-3} sec^{-1}$ and higher; a yield drop is also observed on subsequent reloading after strain aging. The 0.2% offset compressive yield stress of zirconium carbide is 77 kg/mm^2 at 1200°C; it decreases exponentially with temperature to 20 kg/mm^2 at 1800°C. These yield stress values are higher than those reported for any hot pressed and sintered group IVa and Va transition metal carbide. A brittle to ductile transition occurs at approximately 1200°C for ZrC, and the addition of boron increases the transition temperature. The yield stresses have been analyzed in terms of a model in which a dislocation moves by the unpinning of Shockley partials via the diffusion of carbon atoms. An excellent agreement between the calculated activation energy for deformation in zirconium carbide (5.2 eV/atom) and the activation energy for diffusion of carbon supports the model. The strain rate sensitivity parameter m for ZrC, calculated from strain rate change data, decreases with temperature, and the product (mT) decreases linearly with temperature. The alloys show higher values for m, indicating higher internal stresses for these alloys. The activation volume in ZrC is shown to be nearly independent of temperature. The stress relaxation behavior of both zirconium carbide and the alloys depends strongly on temperature, relaxation stress, plastic strain, strain rate before relaxation, and boron content. Recovery takes place during stress relaxation at all temperatures and plastic strains in both ZrC and ZrC + B alloys. The ZrC + B alloys contain platelets of ZrB_2 which probably enhance strength by the Orowan mechanism. Dynamic recrystallization during deformation occurs in both ZrC and ZrC + B alloys which gives serrations during plastic flow. (Diss. Abstr. Int., B)

26254 DOPED CERIA AS A SOLID OXIDE ELECTROLYTE. Tuller, H. L.; Nowick, A. S. (Columbia Univ., New York). J. Electrochem. Soc.; 122: No. 2, 255-259(Feb 1975).

Ceria (CeO_2) doped with divalent or trivalent cations is a mixed conductor; conduction occurs predominantly by the motion of oxygen vacancies or by electrons, depending on the departure from stoichiometry. In order to establish the electrolytic domain (T vs. p_{O_2}) at which $(CeO_2)_{0.95}(Y_2O_3)_{0.05}$ behaves primarily as an ionic conductor with transference number $t_i \geq 0.99$, a careful study was made of the conductivity, σ, as a function of temperature and oxygen partial pressure, covering the p_{O_2} range of 10^0-10^{-22} atm in small steps. From these data the electrolytic domain was determined; it extends to about 10^{-13} atm at 600°C. When compared with calcia-stabilized zirconia (CSZ), doped ceria shows a higher conductivity, lower activation energy (0.76 eV) for anion vacancy migration, and absence of polarization effects to lower temperatures. These results indicate that doped ceria may be an attractive candidate for fuel cells and other applications at temperatures below those at which CSZ is useful. (auth)

26255 NUMBER OF PHYSICAL PROPERTIES OF ZIRCONIUM CARBIDE. Zotov, Yu. P.; Kotel'nikov, R. B.; Kakushadze, L. E.; Migunov, L. V.; Galiakbarov, Z. G. Izv. Akad. Nauk SSSR, Metal.; No. 6, 71-75(1974). (In Russian).

In the temperature interval of 300 to 2500°K a study was made of the heat conductivity and specific electrical resistance of zirconium carbide having compositions from $ZrC_{0.72}$ to $ZrC_{1.49}$. The excess carbon compared to the stoichiometric amount was introduced into the zirconium carbide in the form of carbon black and also in the form of graphite scales. The highest thermal conductivity was found in zirconium carbide having the composition $ZrC_{1.41}$, where the excess carbon was introduced in the form of graphite scales. Extremal values were found on a plot of the thermal conductivity and specific electrical conductivity as a function of composition. On increasing the temperature from 500 to 2000°K, the thermal-conductivity minimum was displaced from the region with a carbon deficit to the region with an excess of carbon. The position of the electrical resistance maximum did not depend on the temperature and corresponded to a composition with ~46.3 at. % C. In the stabilized state, in the interval of temperature from 1500 to 3200°K, the spectral blackness coefficient $\epsilon_{0.65}$ did not depend on the temperature. With a change in composition from $ZrC_{0.72}$ to $ZrC_{0.49}$, it increased from 0.55 to 0.65. (SJR)

26256 STUDY OF PROCESSES TAKING PLACE IN THE REDUCTION OF RHENIUM OXIDES. Uvarova, L. V.; Girenkova, N. I. Izv. Akad. Nauk SSSR, Metal.; No. 6, 46-50(1974). (In Russian).

A study is made of the kinetics of reducing rhenium oxides and ammonium perrhenate in hydrogen and in a nitrogen-hydrogen stoichiometric mixture. The rhenium oxides are reduced more easily and at lower temperatures than ammonium perrhenate. On reducing rhenium oxides, the surface area of the metal gradually increases and passes through a maximum (9.0 m^2/g) at a degree of reduction of about 96 to 97%. The metal surface passes through a maximum on increasing the reduction temperature to 400°C. However on heating to higher temperatures the surface area decreases. By means of the ammonia synthesis reaction and the chemisorption of CO a study was made of the processes of forming nuclei of a new phase and of the development of the separation surface. Heating the sample during reduction to a temperature above 700°C (from 700 to 900°C) does not lead to any changes in the specific volume, the metal surface, or the ammonia yield in the ammonia synthesis reaction. (SJR)

26257 CENTRAL EPR RESONANCE IN REACTOR-IRRADIATED α-Al_2O_3. Galli, A. (CNEN, Rome). Lett. Nuovo Cim.; 11: No. 12, 547-552(23 Nov 1974).

Kinetic aspects of changes in EPR line systems in irradiated α-Al_2O_3 were examined. It was concluded that the observed 13-lines spectrum may be due to complex defects (probably anion divacancies) whose formation does not entail necessarily thermally activated migration—besides affected in general by the charge state—of simple defects at the usual reactor temperatures. A mechanism expressed by an equation is proposed which appears at least suitable to explain the main central-resonance kinetic features in well grown α-Al_2O_3 systems and supports the identification of the central resonance with V^{2-} and F^+ centers. It is noted that the effects of these terms have not been always adequately considered. They instead might clarify kinetic aspects in other systems too, such as for instance the change of the *F-center* production curves in a few alkali halides from a square root to a nearly linear dependence on dose, when the nominal irradiation temperature is lowered enough. The tendency for the interstitials in α-Al_2O_3 to migrate and to cluster appears indicated by the vacancy motion energy value of m ≈ 0.7 G. On comparing EPR and optical-absorption data, oscillator strengths of the expected order of magnitude (f ≈ 1) can be obtained. Moreover, in view of its isotropy, the 205 nm optical-absorption band should be preferably attributed to F^+ centers. (auth)

26258 MICROBEHAVIOR OF U_3Si DURING DEFORMATION. Kimmel, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev); Nadiv, S. (Technion-Israel Inst. of Tech., Haifa). J. Nucl. Mater.; 54: No. 2, 299-312(Dec 1974).

Metallography and X-ray diffraction were used to investigate the texture and microstructure of the intermetallic compound U_3Si after bulk and surface loading. It was found that there is neither an order-disorder transition nor a phase transformation as a result of cold-working of U_3Si. Changes in the X-ray and in the metallographic patterns in deformed martensitic U_3Si were interpreted as being due to detwinning of the {112} ⟨11$\bar{1}$⟩ systems. Detwinning was moderate in the elastic range and considerable in the plastic range. (auth)

26259 ELECTRICAL AND STRUCTURAL CHANGES IN ION-BOMBARDED TiO_2. Studies on Bombardment-Enhanced Conductivity-II. Parker, T.; Kelly, R. (McMaster Univ., Hamilton, Ont.). pp 551-566 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semiconductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226-.

A study of the electrical and structural changes occurring in ion-bombarded TiO_2 was undertaken. The conductivity induced by 30-keV Kr was shown to develop in three fairly distinct regions: (1) incubation period lasting to 6×10^{13} ions/cm^2, during which the conductivity remains near the initial value of about 1.5×10^{-7} ohm^{-1}; (2) rapid increase of conductivity to about 5×10^{-4} ohm^{-1} at 8×10^{16} ions/cm^2; and (3) slow approach of the conductivity to a saturation level of about 1×10^{-4} ohm^{-1} for doses beyond 8×10^{16} ions/cm^2. The concurrent structural changes were determined using reflection electron diffraction, and revealed the amorphization of the initially rutile-type TiO_2 (Region I), the growth of small regions of Ti_2O_3 (Region II), and the complete transformation of the surface to polycrystalline Ti_2O_3 (Region III). The increased conductivity may be adequately explained in terms of the formation of Ti_2O_3. Thus, assuming that the altered layer extends to a depth equal to twice the mean projected range of the bombarding species (~ 230 Å), the value 1×10^{-4} ohm^{-1} corresponds to 1×10^1 ohm^{-1} cm^{-1}. This compares well with the range of values—1×10^2 to 1×10^3 ohm^{-1} cm^{-1}—as given elsewhere for Ti_2O_3. The mechanism responsible for the formation of Ti_2O_3 cannot be specified with certainty, though it is shown that thermal-spike vaporization is inadequate. In effect, the reaction $2TiO_2(s) = Ti_2O_3(s) + \frac{1}{2}O_2(g)$ has too low an oxygen pressure to occur to a significant extent at the surface near an impact. This leaves internal precipitation of O_2 or preferential oxygen sputtering as possible mechanisms. (auth)

26260 ELECTRON TRANSPORT IN SINGLE CRYSTALS OF VANADIUM OXIDE BRONZES. Vinogradov, A.A. (Paviodar Industrial Institute). Sov. Phys.—Solid State 16: No. 7, 1224-1226 (Jan 1975).

The electrical conductivity and the Hall effect have been studied in single crystals of vanadium oxide bronzes in the α phase: $Ag_{0.33}V_2O_5$ (between 128 and 365°K), $Na_{0.33}V_2O_5$ (293°K), and $Cd_{0.33}V_2O_5$ (170 to 300°K) and in the β phase: $Ag_xV_2O_5$(x=0.3, 0.33, and 0.4), $Na_{0.33}V_2O_5$ (293 to 443°K), and $Cd_{0.33}V_2O_5$ (293°K). The Hall mobilities of $Ag_{0.33}V_2O_5$ and $Cd_{0.33}V_2O_5$ decrease with increasing temperature and their values at 293°K are (3.6 to 5.2) $\cdot 10^{-2}$ cm^2/V-sec. The drift mobility of $Ag_{0.33}V_2O_5$ calculated from the electrical conductivity and the thermal emf is also small (~1.2-10^{-2} cm^2/V-sec at 293°K) and increases with increasing temperature. In bronzes of β phase with the univalent metals Ag and Na at 293°K the Hall mobility is 0.15 to 0.3 and the drift mobility, 0.05 to 0.15 cm^2/V-sec, and the mobility increases with increasing temperature. The Hall mobility of $Cd_{0.33}V_2O_5$ is 0.06 cm^2/V-sec. From the data obtained it follows that the most probable carrier transport mechanism in the β phase bronzes is conduction by small-radius polarons or intermediate-radius polarons. A number of theoretical parameters are estimated. (auth)

26261 ELECTRON TRAPPING IN ALUMINUM-IMPLANTED SILICON DIOXIDE FILMS ON SILICON. Johnson, N.M.; Johnson, W.C.; Lampert, M.A. (Department of Electrical Engineering, Princeton University, Princeton, New Jersey 08540). J. Appl. Phys. 46: No. 3, 1216-1222 (Mar 1975).

Photoelectric and MOS capacitance-voltage techniques were used to study electron trapping in 1400-Å dry-grown silicon dioxide films that were implanted with aluminum ions at 20 keV to a fluence of 10^{14} cm^{-2}. The photoinjection of electrons into the implanted oxides resulted in the buildup of negative space charge. Data analysis indicate that all injected electrons had been trapped and that the observed transient responses of the photocurrent and flatband voltage were governed by the electric-field dependence of the photoinjected current. The negative space charge could be annealed either optically by photons of energy exceeding 4 eV or thermally at 350 °C. A 600 °C anneal for 30 min considerably reduced the concentration of electron traps. From this it is concluded that a substantial fraction of the traps were associated with displacement damage created by the ion implantation. (auth)

26262 APPARATUS AND PROCESS FOR THE FORMATION OF DROPLETS. Weitzel, W. H.; Lagrange, L. D. (to Gulf Oil Corp., Houston, Tex. (USA)). French Patent 2174522/D/. 12 Jan 1973. Priority date 14 Jan 1972, USA. 19p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention described an apparatus and a procedure for dispersing an initial liquid material in the form of uniform spherical droplets. The apparatus consists of a device forming a liquid feed jet, a device to create uniform periodic varicose instabilities of the jet, and a device to produce a coaxial flow in the same direction of gases surrounding the jet in order to reinforce the

varicose instabilities and to disperse the jet in the form of uniform spherical droplets. The varicose instabilities have, preferentially, a wave length equal to at least x times the diameter of the undisturbed jet. (tr-FR)

26263 INVESTIGATION OF THE ENHANCEMENT MECHANISMS OF THE OXIDE TREATMENT ON CEMENTED CARBIDE TOOLS. Naik, S. K.; Suh, N. P. (Massachusetts Inst. of Tech., Cambridge). J. Eng. Ind.; 97: No. 1, 112-118(Feb 1975).

The mechanisms responsible for enhancement of the metal cutting properties of cemented carbide tools during oxide treatments are investigated. The reaction of individual phases present in cemented carbide tools with various oxides was analyzed experimentally under temperature-pressure conditions previously employed for the oxide treatment. The change in the surface structure and the formation of new phases were determined by means of X-ray diffraction, oxidation experiments, and thermodynamic analyses. The experimental results show that during the oxide treatment such carbides as TiC and ZrC, which are chemically more stable than WC, form on the surface of WC. It was also found that a small percentage of oxides mixed in the eutectic phase of Co-WC stabilizes the eutectic phase, thus preventing its adhesion to a solid piece of oxides. (auth)

26264 SINTERING BEHAVIOR OF BORON. German, R. M. (Sandia Labs., Livermore, CA); Mar, R. W.; Hastings, J. C. Amer. Ceram. Soc. Bull.; 54: No. 2, 178-181(Feb 1975).

From 26th Pacific coast regional meeting of the American Ceramic Society; San Francisco, CA (1 Nov 1973).

The sintering behavior of crystalline boron was investigated over the 2155 to 2268 K range and the effects of temperature, time and particle size were examined. Sintering progress was monitored by density and specific surface area changes. No densification took place upon sintering, but there were marked changes in specific surface areas and microstructural morphology. Results are discussed in terms of the surface diffusion and evaporation-condensation mechanisms. Sintering behavior is interpreted in light of the low atomic bonding symmetry of boron. (auth)

26265 GAS ISOSTATIC HOT PRESSING WITHOUT MOLDS. Heardtl, K. H. (Philips Forschungslaboratorium GmbH, Aachen). Amer. Ceram. Soc. Bull.; 54: No. 2, 201-205; 207(Feb 1975).

Isostatic hot pressing without molds is a novel means to eliminate residual porosity from normally sintered ceramic specimens. The pressure is transmitted by inert gases. The essential condition for effective hot pressing without molds is that the pores are not connected with the surface, but are of the "closed" type. This process is very simple with respect to engineering and is suitable for mass production because: (1) no mold is necessary. There are no problems caused by a contact between the ceramic and the material of the mold or die; (2) ceramics of arbitrary shape can be hot pressed; (3) relatively low pressures (50-200 bars) and low temperatures (≈ 100°C) below normal sintering temperature) are needed. In this way, ceramics of $BaTiO_3$, $SrTiO_3$, $Pb(Zr, Ti)O_3$, Al_2O_3, $Y_3Fe_5O_{12}$(YIG), Mn-Zn ferrite and Ni-Zn ferrite have been densified to virtually theoretical density. (auth)

26266 EFFECTIVE SURFACE ENERGY AND STRENGTH OF BRITTLE WC-Co ALLOYS. Tumanov, V. I.; Konyukhova, L. A.; Kreimer, G. S. (All-Union Scientific-Research and Design Inst. for Refractory Metals and Rigid Alloys, Moscow). Fiz. Metal. Metalloved.; 38: No. 4, 843-849(Oct 1974). (In Russian).

For thin samples with preliminarily drawn deep notches were made, under controlled destruction conditions, "load-bend" diagrams were made for the alloys WC-6% Co and WC-15% Co with carbide grains averaging from 1.6 to 5.2 μm in size. The effective surface energy was calculated for these alloys by an analytical method. For alloys with average grain size 1.6 to 1.7 μm, in which cracks appeared in the Co phase, values obtained were 6×10^4 and 15×10^4 ergs/cm^2, respectively, for 6 and 15% Co. This confirms that the effective surface energy is proportional to the Co content. The coefficient of proportionality is 10^6 ergs/cm^2. It was also confirmed that the critical length of the crack, which enters into the Griffiths equation, does not depend on the Co content, f_{Co}, in the limits studied. Calculated values for the constant A, in the equation $\delta^2 = AEf_{Co}$, for small-grain WC-Co alloys agreed satisfactorily with experimental data. (tr-auth)

26267 NUCLEAR MAGNETIC RESONANCE IN TITANIUM-ZIRCONIUM-HYDROGEN SYSTEM AND DIFFUSION OF HYDROGEN ATOMS. Khodosov, E. F.; Prokopenko, A. K.; Linnik, A. I. (Donetsk Inst. of Physics and Chemistry, USSR). Fiz. Metal. Metalloved.; 38: No. 4, 746-750(Oct 1974). (In Russian).

Using stationary and pulsed nuclear magnetic resonance, NMR spectra and nuclear magnetic spin-lattice relaxation time were studied in Ti-Zr-H systems of different compositions. Evidence was obtained on the redistribution of hydrogen atoms in the internode crystalline lattice, and self-diffusion parameters of hydrogen atoms was studied at temperatures from 500 to 850°K. (tr-auth)

26268 CLASSIFICATION AND ANALYSIS OF THE IMPURITY ION CLUSTERS IN $Y_3Al_5O_{12}$. Voronko, Yu. K.; Sobol, A. A. (Lebedev Inst. of Physics, Moscow). Phys. Status Solidi (a); 27: No. 1, 257-263(16 Jan 1975).

A classification is made of complicated impurity associates for crystals of $Y_3Al_5O_{12}-Lu_3Al_5O_{12}:A^{3+}$ (A^{3+} = Nd^{3+}, Eu^{3+} or Pr^{3+}), $Y_3Al_5O_{12}-L_3Al_2Si_3O_{12}:Nd^{3+}$ (L^{2+} = Mg^{2+}, Mn^{2+} or Ca^{2+}) and $Y_3Al_5O_{12}:Sc^{3+}$-(Nd^{3+}, Eu^{3+}). The mechanism is investigated of formation of associations of different type by means of an analysis of the inhomogeneous splitting and broadening of the spectral lines of the A^{3+} ions. Some possible models are discussed. The effect is studied of the valency and sizes of the impurity ions on the symmetry of the crystal field of the complicated impurity associates. (auth)

26269 CONDUCTIVITY INVESTIGATION OF CaV_2O_6. Belyaninov, Yu. N.; Grunin, V. S.; Zonn, Z. N.; Ioffe, V. A.; Patrina, I. B.; Yanchevskaya, I. S. (Inst. of Silicate Chemistry, Leningrad). Phys. Status Solidi (a); 27: No. 1, 165-173(16 Jan 1975).

An investigation was made of conductivity and EPR spectra of CaV_2O_6 crystals. It is shown that a correlation exists between conductivity and number of the V^{4+} ions. There is no direct overlap between the ground states of the extra electrons on the neighboring V atoms. The dependence of σ in CaV_2O_6 on temperature and frequency is in good agreement with the theory of conductivity assuming thermally activated hopping between the localized states. (auth)

26270 EFFECT OF IRRADIATION ON DIELECTRIC PROPERTIES OF FERROELECTRIC CERAMICS. Petrenko, A. G.; Shipatov, E. T.; Ievenko, L. A.; Klimov, V. V.; Prisedskii, V. V.; Zhaglo, V. P. (Donets State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 146-147(1974). (In Russian).

The effect of electron irradiation on the dielectric constant ε and the tangent of the loss angle tgδ of the ferroelectric solid solutions $Pb_{0.3}Sr_{0.7}TiO_3$ and $Pb_{0.95}Sr_{0.05}(Ti_{0.47}Zr_{0.53})O_3$ was studied at electron doses of 0.56×10^{17} and 2.4×10^{17} electrons/cm^2 at temperatures from −150 to 150°C. The temperature dependence of ε is graphed for both ferroelectrics. For both samples tg δ was changed very little by irradiation. The results showed that the dielectric parameters are substantially altered by irradiation. (JSR)

26271 ROLE OF INCLUSIONS IN THE FRACTURE INITIATION PROCESS IN WC-Co ALLOYS. Luyckx, S. B. (Univ. of the Witwatersrand, Johannesburg). Acta Met.; 23: No. 1, 109-115(Jan 1975).

Fractographic studies by scanning electron microscopy have been carried out on WC-Co specimens fractured in bending, fatigue and diametral compression. Subsequent X-ray microanalysis has revealed that the fracture origin in all types of specimens is generally associated with a microscopic inclusion, mostly of Si, Fe, Al or C. (auth)

26272 SINTERING MECHANISMS IN THORIA GEL. Bannister, M. J. (Australian Atomic Energy Research Establishment, New South Wales). J. Amer. Ceram. Soc.; 58: No. 1-2, 10-14 (1975).

Isothermal sintering experiments were combined with measurements of crystallite size distribution and BET surface area in a study of the sintering mechanisms in thoria gel. The results suggest that crystallites in the gel have a coordination number of ≈ 5 and sinter together by a grain boundary diffusion mechanism. (auth)

26273 CREEP FRACTURE IN UO_2. Reynolds, G. L.; Burton, B.; Speight, M. V. (Central Electricity Generating Board, Berkeley, Eng.). Scr. Met.; 9: No. 3, IX(Mar 1975).

Creep fracture processes have been studied in UO_2. At high rates of strain, fracture occurs by the propagation of the triple point cracks which extend large distances along grain boundaries. At lower rates of strain, the fracture mode involves the growth of rounded cavities on boundaries parallel to the compressive stress axis. The growth of these cavities is attributed to a vacancy condensation mechanism driven by internally generated tensile components of stress. The magnitude of this tensile stress is calculated and the conditions for growth are estimated. It is shown that non-stoichiometric and large grained material is more susceptible to creep damage. This increased susceptibility is attributed to the increased magnitude in grain boundary sliding offsets in the large grained material and to increased ease of sliding in the non-stoichiometric material. (auth)

26274 SOLUBILITY LIMIT OF La IN THE LEAD ZIRCONATE-TITANATE SYSTEM. Schulze, W. A.; Miller, T. G.; Biggers, J. V. (Pennsylvania State Univ., University Park). J. Amer. Ceram. Soc.; 58: No. 1-2, 21-23(1975).

From Fall meeting of the Electronics Division of the American Ceramic Society; Atlanta, GA (10 Sep 1973).

The disappearing-phase method was used to determine the extent of the solid-solution region of the PLZT system for conventionally sintered ceramics prepared at 1100° and 1300°C in a PbO atmosphere provided by $PbZrO_3$. A decrease in the firing temperature from 1300° to 1100°C lowers the solubility limit by 5 to 8 at.% La. Beyond the limits of solubility, additional La forms $La_2Zr_3O_7$ and/or $La_2Ti_2O_7$. The limit determined by the disappearing-phase method (1300°C firing) is compared to values determined by the parametric method. The Curie temperature is stabilized at 5 at.% for modified $PbZrO_3$ (1300°C firing). (auth)

26275 TRANSFORMATIONAL HOT-WORKING OF ZrO_2 POLYCRYSTALS. Bansal, G. K.; Heuer, A. H. (Case Western Reserve Univ., Cleveland). J. Amer. Ceram. Soc.; 58: No. 1-2, 76-77(1975).

On the basis of an observed correlation between deformation during hot-working and increases of density, it is believed that transformational superplasticity is not present during the monoclinic ⇌ tetragonal transformation in ZrO_2. However, densification is enhanced during the phase transformation and may be associated with the transformation-induced deformation. Above ≈1200°C, where the ZrO_2 exists as a tetragonal phase, plastic deformation is possible. This deformation probably involves both conventional slip and grain-boundary sliding. (PMA)

26276 VOLUME CHANGES IN IRRADIATED UO_2 FUEL. Hastings, I. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Rose, D. H.; Schankula, M. H. J. Amer. Ceram. Soc.; 58: No. 1-2, 74(1975).

This note reports volume changes in UO_2 fuel irradiated in WR1, an organic-cooled, heavy-water moderated research reactor located at Pinawa, Manitoba. Four UO_2 fuel elements, clad with Zr-2.5 wt % Nb and irradiated in the reactor under similar conditions, were selected for examination. Samples 1 by 1 by 5 mm were cut from radial positions in the sections; their density was measured by an immersion technique used successfully with U_3Si fuel. The precision cutting technique permitted accurate determination of the positions of the samples in the fuel. Volume changes were correlated with microstructure observed by optical and electron microscopy. Regions of irradiation-induced volume change identified in UO_2 fuel occurred: (1) at ≲1300°K, where densification occurs by removal of sintering porosity; (2) from 1300 to 1900°K, where swelling caused by intergranular fission gas bubbles predominates; and (3) at >1900°K, in the region of columnar growth, where both swelling and densification are observed. (PMA)

Metals and Alloys

Refer also to abstracts 26239 and 28331.

26277 (ANSC-SAR-15-A872) SURFACE ALLOYING TECHNOLOGY PROGRAM REPORT. I.R. and D. (December 1, 1969–November 30, 1970. Rehn, I. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1970. 36p. Dep. NTIS $5.00.

Initial examination of diffused surface alloys indicates that reliable, hard-case surfaces are feasible on austenitic steels and high-strength, nickel-base alloys as improved, nonbrittle cyrogenic bearing materials. Effort was directed to an evaluation of potential applications of the developing technology of surface alloys and metalliding. A friction test machine was designed, built and operated while the specimen material was ordered, machined and submitted for metalliding at two subcontractors' facilities. A third source, Battelle, adapted a chemical vapor deposition process to prepare diffused surface alloys and submitted same for testing during the last week in November 1970. Only partial deliveries from one source of metallided specimens were received before 25 November 1970; however, significant success was reported in producing metallided cases on alloys which had not formerly been treated. The excellent, hard case achieved on Kovar at Battelle was not regarded as unique to that alloy but representative of a low-expansion austenitic steel. The same applies to the specimens of 718 which are representative of several nickel-base alloys. The balance of the specimens from seven alloys being metallided (to be delivered December 1970 to January 1971) was designed to show how generally applicable this process is to the high-strength nickel-base alloys. The borided specimens tested in liquid nitrogen demonstrated low coefficients of friction and no significant wear under the same conditions which caused 440C (Rc 60) to gall rapidly against a 440C ring. (auth)

26278 (ORNL-TM-2217) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1968. Patriarca, P. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Jun 1968. Contract W-7405-eng-26. 279p. Dep. NTIS $17.00.

Research is reported on fuel element fabrication, welding of reactor materials, LMFBR cladding materials, mixed nitride fuels, nondestructive testing, sintered Al materials, Sol-Gel fuels, Zr metallurgy, radiation effects on fuels, and radiation effects on structural materials. (JRD)

26279 (RN-S-0535) MATERIALS DATA MATURING PLAN FOR PDR. Funk, C. W.; Odgers, I. L.; Evleth, R. V. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 23p. Dep. NTIS $4.25.

Data on properties of Nerva reactor materials are presented. Information is included on Inconel 718, Alloy A286, Waspaloy, Hastelloy X stainless steel 347, Ti-base alloys, glass laminates, Al-base alloys, Udimet, Hastelloy C, stainless steel 301, polymers, coatings, and graphite. (JRD)

26280 (RN-TM-0358) SURVEY OF BEARING RETAINER MATERIALS. Matt, R.; Emmons, W. F. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1966. 33p. Dep. NTIS $4.75.

Declassified 13 Mar 1975.

Results of the survey show that commercially proven materials or designs currently available for the high speed, load, of the NERVA engine have a finite limit of radiation resistance of 10^{18} nvt or 10^{10} ergs/g (C). Molybdenum disulfide is the best available solid film lubricant for the NERVA application. Although metal halides may provide greater lubrication for 440-C than MoS_2 their state of development is not extensive. MoS_2-reservoir retainer fabricated of TZM molybdenum or M-10 steel, as developed by Naval Air Engineering Center, is a proven retainer for cryogenic application at low speeds and loads. TZM molybdenum is the better material of the two. (auth)

26281 (TID/SNA-383) NERVA MATERIALS PROGRAM PLAN, S131-CP090290AF1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 37p. Dep. NTIS $5.00.

Methods to assure that Nerva materials meet performance requirements are described. Information is included on materials management, material services and design activities, materials data generation, technical directives, quality control, and alloy ductile-brittle classification. (JRD)

26282 (TID/SNA-518) MATERIALS AND PROCESSING DEVELOPMENT ACTIVITIES. Project 187. Quarterly Progress Report, Second Quarter 1971. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1971. 119p. Dep. NTIS $9.25.

Research on Nerva reactor materials is reported. Information is included on radiation effects on reactor materials, mechanical properties of reactor materials, and shielding materials development. (JRD)

26283 (TID/SNA-624) MATERIALS AND PROCESSING DEVELOPMENT ACTIVITIES, SECOND QUARTER 1971, s131-MQR09-W187f. Quarterly Progress Report, Second Quarter CY 71. Project 187. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1971. 118p. Dep. NTIS $9.00.

Research on Nerva reactor materials is reported. Information is included on radiation effects on reactor materials, mechanical properties of reactor materials, and shielding materials development. (JRD)

26284 (TID/SNA-834) NERVA MATERIALS DEVELOPMENTS FOURTH QUARTER, CONTRACT YEAR 1970 (July, August, and September); s131-PR04-W187f2e. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 358p. Dep. NTIS $21.00.

Materials and processes development activities for the fourth quarter of Contract Year 1970 are reported. Materials development topics include: (1) planning material test activities for CY 71 and beyond; (2) development of analysis techniques to adjust heterogeneous data; (3) determination of thermal conductivity for AISI 347 stainless steel and elastic moduli and Poisson's ratio for Inconel 718 and Ti–5Al–2.5Sn (ELI); (4) embrittlement effects of 1400 psi gaseous hydrogen on alloy 718 and Ti–5Al–2.5Sn (ELI); (5) cryogenic radiation damage of Ti–5Al–2.5Sn (ELI); and (6) evaluation of prepreg, impregnation, and fabric materials for optimum fibrous graphite properties. Component support topics include: (1) tensile design allowable development of Ti–5Al–2.5Sn (ELI) for turbopump applications; (2) evaluation of fatigue, fracture toughness, and stress corrosion properties of AA 7039-T63 for pressure vessel applications; (3) development of AISI 347 sheet tensile and creep properties for nozzle

applications; (4) evaluation of orbital weld techniques for aluminum line fabrication; (5) material selection of shield materials; (6) development of high load friction and wear properties of hard chrome/gold plate combinations; (7) revision of Contamination and Corrosion Control Plan; and (8) evaluation of weld processes for NASS duct coolant channel fabrication. (auth)

Corrosion and Erosion

Refer also to abstract 28012.

26285 (AD-783564) FEATURES OF THE PROCESS OF ONE- AND TWO-COMPONENT SURFACE ALLOYING OF ALLOY ZH56-K FROM SUSPENSIONS. Zemskov, G. V.; Kogan, R. L.; Moroz, V. I. Translated from Zashch. Pokrytiya Metal.; No. 6, 109-112(1972). 15p. (FTD-MT-24-1342-74). NTIS $3.00.

The work investigates the features of the process of saturation of alloy ZHS6-K by aluminum, silicon, boron, chromium, zirconium, and also aluminum together with the other indicated elements. Saturation was accomplished by the deposition of a suspension, consisting of dispersed particles of the saturating elements and solution of nitrocellulose (colloxylin), on the surface of the sample after the homogenizing of samples in a protective atmosphere (argon, vacuum). (GRA)

26286 (KFK-2033) INCOLOY ALLOY 800: STEAM CORROSION EXPERIMENTS UNDER HEAT TRANSFER AND ISOTHERMAL STEAM CORROSION TESTING OF VARIOUS SUPERHEAT MATERIALS IN A HIGH PRESSURE LOOP (FINAL REPORT HKW). Leistikow, S.; Berg, H. V.; Jennert, D.; Erbacher, F.; Vasarhelyi, J. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). Dec 1974. 168p. (In German). Dep. NTIS (US Sales Only) $11.50.

For steam corrosion testing of superheat materials under high heat fluxes, a high pressure steam loop was constructed and successfully operated during two years. Indirect electrically heated Incoloy Alloy 800 thin wall tubing was tested at 450-700°C, 150 atm, 200 W/cm^2, 16-50 m/sec, while various superheat materials were isothermally exposed at 600°C, 150 atm, 3.5 m/sec as coupons or tube sections. The corrosion experiments under heat transfer showed that—under the applied conditions and in comparison to isothermally exposed tube sections—no increased corrosion effect was exerted by loop exposure. Oxidation kinetics were governed by a parabolic rate law. Only in case of long-time application can pessimistic assumptions (such as stress-induced spalling) justify the extrapolation of increased metal losses. Isothermal testing of various cold deformed superheat materials proved high corrosion resistance under the applied dynamic loop conditions and long-time exposures. (auth)

26287 (WARD-NA-3045-19) SODIUM TECHNOLOGY PROGRAM: FRICTION, WEAR, AND SELF-WELDING. Quarterly Progress Report for Period Ending October 31, 1974. Ray, W. E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Feb 1975. Contract AT(11-1)-3045. 58p. AT.

There are currently four materials couples being investigated in support of the instrument tree lower radial bearing interface. Initial 450°F testing indicates that the Tribaloy 700 material couples are superior to the Haynes 273 couples. Testing of irradiated chromium carbide materials was completed through 1160°F. Only at the highest temperature did the friction coefficient differ from those of unirradiated samples. A hybrid materials test of CN-1b chromium carbide/aluminized Inconel 718 through 1160°F showed that friction coefficient values increase with increasing contact pressure at 450°F. This trend is reversed at 1000° and 1160°F test temperatures. A test on a chromium-plated type 304 stainless steel materials couple was terminated after an examination subsequent to the first rubbing phase revealed catastrophic wear. Post-test specimen evaluation of as-received and sodium pre-exposed Inconel 718/Haynes 273 materials revealed that no significant difference in wear behavior occurred. Self-welding evaluation in sodium for FFTF component materials showed that, after four months at 850°F, no self-welding was identified for Stellite 6 on Stellite 6, Stellite 156 on Stellite 156, and Inconel 718 on Inconel 718 at various contacting stresses. Concerning the sodium compatibility of low friction materials, the current reference duct load pad coating, chromium carbide/nichrome on Type 316 stainless steel, had an average corrosion rate of 0.11 mpy after 8023 hours exposure to 1160°F sodium. (PMA)

26288 (WARD-NA-3045-20) EVALUATION OF TURCO PRETREAT: A COATING USED TO INHIBIT SCALING DURING THE HEAT TREATMENT OF STAINLESS STEEL. Bagnall, C.; France, L. L.; Leasure, R. A. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Feb 1975. Contract AT(11-1)-3045. 60p. AT.

Although Turco Pretreat has been successfully used by vendors for a variety of applications, it was considered inadvisable to apply the compound to stainless steel components built for use in the Fast Flux Test Facility (FFTF) without subjecting the product to a closer simulation of the proposed production heat treatment cycle. Accordingly, a program to provide this additional information was conducted. The initial work embraced extremes of environmental conditions beyond those anticipated for heat treatment and included a study on the efficiency with which sodium at 950°F would remove Turco residue from heat treated components. These experiments revealed one instance of cracking in a steam-tested specimen (not coated with Turco, but in the presence of others with the coating) and demonstrated that sodium would not take the place of mechanical cleaning. Further experiments with stressed and unstressed Type 304 stainless steel in both laboratory and vendor plant simulation of the planned heat treatment cycle yielded no evidence of mechanical impairment of the Turco-coated surfaces and clearly demonstrated the advantage, both from an economic and a physical standpoint, to be gained from its use as a protection against oxidation of the reactor components during high temperature heat treatments. On the basis of the tests performed, it is recommended that "Turco Pretreat" be used on stainless steel and nickel alloy parts prior to heat treatment. Its use, however, shall be limited to parts that do not contain crevices or inaccessible areas. (auth)

26289 (WAPD-TM-1045) CORROSION CHARACTERISTICS OF ZIRCALOY-4 CONTAINING ADDED SILICON. Kass, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Bettis Atomic Power Div.). Jan 1975. Contract AT(36-1)-GEN-14. 60p. Dep. NTIS $6.00.

Tests with a Zircaloy-4 alloy containing 230 ppM added silicon have demonstrated that the alloy can be hot worked in or slowly cooled through the two phase alpha-plus-beta region without resulting in impaired corrosion resistance. The corrosion kinetics of Zircaloy-4 with or without the added silicon are very similar; a two stage corrosion process, pre-transition and post-transition, is followed. The silicon bearing alloy corrodes more rapidly than normal Zircaloy-4, but the difference between the behaviors in hot water at 640 and 680°F are judged to be of little or no consequence. The silicon addition to Zircaloy-4 renders the alloy less prone to absorb hydrogen during corrosion exposure. (auth)

26290 (Y-1397(Rev.1)) BERYLLIUM CORROSION IN WATER, ALCOHOL, AND HYDRATED GYPSUM MEDIA. Schmitt, C. R. (Oak Ridge Y-12 Plant, Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 24p. Dep. NTIS $4.00.

Laboratory tests were made to evaluate the corrosion resistance of: (1) unalloyed beryllium and anodized beryllium in demineralized and tap water solutions; (2) silver-brazed beryllium in pure and water-contaminated methyl alcohol solutions; and (3) galvanic couples of copper, brass, and aluminum to beryllium embedded in hydrated gypsum molds. Comparison of corrosion resistance results show that anodized beryllium is superior to unalloyed beryllium, that the corrosion of silver-brazed beryllium is a result of galvanic action, and that appreciable galvanic corrosion of beryllium occurs when it is coupled to a dissimilar metal in a hydrated gypsum mold. (auth)

26291 (Y-DA-6063) CORROSION OF TUNGSTEN-3.5 NICKEL-1.5 IRON AND ITS CONSTITUENT PHASES IN AQUEOUS CHLORIDE SOLUTIONS. Koger, J. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 18 Nov 1974. Contract W-7405-eng-26. 29p. (CONF-750404-1). Dep. NTIS $4.50.

From Corrosion/75 Conference; Toronto, Canada (14 Apr 1975).

The corrosion characteristics of tungsten-3.5 nickel-1.5 iron were determined by potentiostatic polarization methods in aqueous chloride solutions of varying pH. For comparison purposes, the constituent phases of the alloy, other alloys of tungsten, nickel and iron, and the pure elements were also studied. The alloy exhibited an active-passive transition in aqueous 0.1 M NaCl solutions of pH = 4, 9, and 12.5, and the current density (corrosion rate) increased with increasing pH. Tungsten and tungsten alloys were more resistant to acid solutions, while nickel and nickel alloys were more resistant to basic solutions. (PMA)

26292 FORM OF OXIDE CRYSTALLIZATION IN MOLYBDENUM. Savitskii, E. M.; Burkhanov, G. S.; Kirillova, V. M.; Ottenberg, E. V. (Moscow Inst. of Metallurgy). Dokl. Akad. Nauk SSSR; 217: No. 6, 1305-1306(21 Aug 1974). (In Russian).

The form and distribution of oxide inclusions in cast Mo with 0.1 and 0.01 wt.% oxygen were studied with a scanning electron microscope. In the Mo containing 0.01 wt.% oxygen, the oxides are

located on the surface of the crystal in the form of a film covered with pores. The composition of the oxide film is MoO_2. With increase of the oxygen concentration to 0.1 wt.%, the oxides coat the surface of all Mo crystals in the form of a solid film. The film consists either of individual parallel butt-joined platelets or disc-shaped precipitations. The composition of this film is also MoO_2. (JSR)

26293 ON THE ANODIC OXIDATION OF MOLYBDENUM. Daly, C. M.; Keil, R. G. (Univ. of Dayton, OH). J. Electrochem. Soc.; 122: No. 3, 350-353(Mar 1975).

The anodic oxidation of molybdenum in an acetic acid solution was studied with regard to the nature of the formed film and the kinetics of film growth. Faradaic methods, ATR spectroscopy, and "open-current" transient methods were utilized. A comparison was made between the anodic oxide film formed on molybdenum and vanadium. The anodic film on molybdenum was found to contain molybdenum in an oxidation state less than + 6. (auth)

26294 STUDY OF THE DIFFUSION OF OXYGEN IN ALPHA-ZIRCONIUM BY MEANS OF NUCLEAR MICROANALYSIS. David, D. (CNRS, Paris); Amsel, G.; Boisot, P.; Berange, G. J. Electrochem. Soc.; 122: No. 3, 388-396(Mar 1975).

Polycrystalline zirconium samples were oxidized in pure oxygen under atmospheric pressure at 700 to 845°C and for times up to 400 h. Diffusion of oxygen in the metal, beneath the oxide layer formed, was studied using a direct quantitative method of analysis based on the observation of the nuclear reaction $^{16}O(d,p)^{17m}O$. It was found that at a given temperature the oxygen concentration profiles, referred to the oxide-metal interface, may be superimposed after scaling by a factor $\sqrt{t}$. Results may be fitted assuming a concentration-independent diffusion coefficient D, the oxygen concentration at the oxide-metal interface being constant and nearly equal to the saturation value, around 30 atom %. An activation energy Q = (49 ± 1) kcal/mole was found for the process. Identical results were obtained in air, showing that, at atmospheric pressure, nitrogen in the air plays a negligible role in the dry corrosion of zirconium. (7 fig.) (auth)

26295 INFRARED REFLECTANCE SPECTRA (IRRS) OF ANODIC OXIDE FILMS ON PURE TANTALUM FORMED IN PHOSPHORIC ACID. Takamura, T.; Kihara-Morishita, H. (Tokyo Shibaura Electric Co., Ltd.). J. Electrochem. Soc.; 122: No. 3, 386-387(Mar 1975).

The IRRS of the anodic oxide films has a broad band at 900 cm^{-1}, with three components 925, 860, and 800 cm^{-1}, and a small band at 1100 cm^{-1}. The intensities of the 925 and 800 cm^{-1} components increase linearly with thickness, but the rate of increase becomes slow in the 70-90 V region. The intensities were independent of the H_3PO_4 content. The 1100 cm^{-1} band intensified linearly with the quantity of forming voltage (film thickness) and logarithmically with the phosphate content. The 610 cm^{-1} band also increased. (DLC)

26296 STUDY OF THE EFFECT OF CORROSION BY SODIUM ON AUSTENITIC STEELS USING A SCANNING ELECTRON MICROSCOPE. Borgstedt, H. U. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). J. Nucl. Mater.; 54: No. 2, 233-240(Dec 1974). (In German).

Corrosion by sodium in a closed loop with temperature gradients is characterized by solution of components of structural materials in the high-temperature zone, transport of dissolved matter along the thermal gradient and deposition in the low-temperature zone. The scanning electron microscope reveals the morphology of the corrosion effects in the hot zone and of the deposited matter in the cool zone. The use of non-dispersive X-ray analysis in conjunction with the scanning microscope can also give information about shifts in chemical composition in both zones. Even single particles 10^{-4} cm in diameter can be qualitatively analyzed. The possibilities of corrosion research with the scanning electron microscope are exemplified by investigation of samples which have been corroded in the hot zone, or covered partly or wholly with deposited layers in the cool zone. (auth)

26297 CONTRIBUTION TO THE STUDY OF THE CORROSION OF A LOW CARBON AUSTENITIC STEEL (AFNOR Z3 CN 18-10) BY LIQUID SODIUM AT 700 DEG C. Baque, P.; Lafon, A.; Sermet, E.; Champeix, L. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). J. Nucl. Mater.; 54: No. 2, 241-244(Dec 1974). (In French).

304 L SS samples were exposed in a moving liquid sodium stream, up to 700°C, for 150 h to 4000 h. Different types of examinations show that the major mechanism of corrosion of the alloy is the diffusion of certain elements towards the sodium. This diffusion induces a progressive ferritization of the superficial layer; this phase modification reveals a change towards a new thermodynamic equilibrium state. (auth)

26298 STUDY OF CORROSION PHENOMENA FOLLOWING A SODIUM-WATER MICRO-REACTION IN A CRACK TRAVERSING A VAPOUR GENERATOR TUBE OF A FAST REACTOR. Donati, J. R.; Grand, M.; Spiteri, P. (Electricite de France, 77 - Ecuelles. Centre de Recherches et d'Essais des Renardieres). J. Nucl. Mater.; 54: No. 2, 217-223(Dec 1974). (In French).

Caustic corrosion phenomena of LMFBR steam-generator tubes, occurring during sodium-water reactions inside thin cracks through the tube walls, were studied. Tests were performed on 2.25 Cr-1 Mo evaporator tubes and 321 H superheater tubes. It was found that the ferritic material endures general corrosion resulting in the widening of the initial crack. On the contrary, the cracking of the austenitic material is intergranular. Among the corrosion products, mainly consisting of sodium chromite, deposits of pure iron (or iron-nickel alloy) were noticed. (auth)

26299 INFLUENCE OF THE ADDITION OF COPPER ON THE OXIDATION KINETICS OF HAFNIUM. Pieraggi, B.; Dabosi, F. (Ecole Nationale Superieure de Chimie, 31 - Toulouse (France)). J. Nucl. Mater.; 54: No. 2, 224-232(Dec 1974). (In French).

The oxidation kinetics, in air between 800 and 950°C, of two Hf-Cu alloys containing 3.30 and 5.60 at % Cu were studied. In accordance with earlier studies by others of binary Zr-Cu alloys, the addition of copper to hafnium leads to an improvement of oxidation resistance and the elimination of oxide layer degradation. The formation of a layer of Hf_2Cu between the alloy substrate and the HfO_2 layer was verified. This Hf_2Cu layer appears to slow the dissolution of oxygen, thereby slowing down the rate of oxidation. (auth)

26300 USE OF THE NUCLEAR γ RESONANCE METHOD FOR STUDYING THE CORROSION OF Zr-BASED ALLOYS. Babikova, Yu. F.; Gruzi, P. L.; Filippov, V. P.; Shtan, I. I. pp 17-22 of Prikladnaya yadernaya spektroskopiya. Latyshev, G. D. (Ed.). Moscow; Atomizdat (1974). (In Russian).

Redistribution of Fe and Sn atoms in films on Zr alloys containing 1.21 wt.% Fe, 1.50 wt.% Fe, or 1.21 wt.% Sn was studied by nuclear γ resonance. The alloys were first rolled to foils with a thickness of 0.5 mm and 20 to 40 μm. The foils were annealed at 750°C for 30 min. The foils were then oxidized in air or steam at various temperatures for varying lengths of times. Typical NMR spectra were given. The Fe and Sn distribution in the oxide films were determined. Qualitative and quantitative data on the change of the phase composition of the oxide film could be obtained with the NMR method. (JSR)

26301 INTERACTION OF ALUMINUM, TITANIUM, AND ZIRCONIUM WITH OXYGEN IN LIQUID MOLYBDENUM. Kashin, V. I.; Klibanov, E. L.; Semenov, V. G.; Binogradov, N. I. pp 113-118 of Kinetika i Termodinamika Vzaimodeistviya Gazov s Zhidkimi Metallami. Ageev, N. V. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

From Symposium on kinetics and thermodynamics of the interactions of gases with liquid metals; Moscow, USSR (17 Oct 1972). See CONF-7210128-.

A method was developed for the experimental determination of the reducing capacity of elements in liquid refractory metals. The equilibrium constants of the reduction reaction of Mo by Al, Zr, and Ti were determined and their activity coefficients were evaluated. Of the elements examined only Ti, under the given experimental conditions, can significantly reduce the oxygen content in liquid Mo. (tr-auth)

26302 INVESTIGATION OF HOT CORROSION MORPHOLOGY BY COLOR X-RAY DISTRIBUTION IMAGING. McKee, D. W.; McConnell, M.; Bolon, R. B.; Romeo, G. (General Electric Co., Schenectady, NY). Met. Trans.; 6A: No. 2, 257-264(Feb 1975).

The structure of corrosion layers on nickel-base alloys resulting from reaction with sulfur dioxide and sodium sulfate at elevated temperatures (hot corrosion) has been studied by the method of color X-ray distribution imaging. This technique involves the preparation of color composite prints by superimposing primary color images of the individual element X-ray distributions on a single sheet of color film. By a proper choice of primary tints, the distribution of reaction products and other features of the corrosion morphology can be clearly defined as a result of color mixing in the composite micrograph. The distribution of corrosion products in the surface layers of Ni-Cr and Ni-Al alloys and an IN 738 specimen following sulfidation was investigated using this technique. (auth)

Preparation and Fabrication

Refer also to abstracts 27978, 28133, and 28628.

26303 (RN-S-0515) EVALUATION OF CONSUMABLE WELD INSERTS FOR NERVA LINE WELDS. Fletcher, C. W. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jun 1969. 24p. Dep. NTIS $4.25.

Three types of consumable weld inserts were evaluated. Two types exhibited the best weldability characteristics and minimum weld shrinkage for the tube wall thickness (0.120 in.) utilized in the program. Complete fusion of the insert and uniformity of underbead contour were difficult to achieve with the third type. A mixture of 85% argon–15% hydrogen as the torch shielding gas, in combination with optimum ID weld backup shielding, consistently produced the smooth, contoured, low-crown underbead desired. (auth)

26304 (RN-TM-0301) XE FLAME SPRAY CAPABILITY TESTS FOR TITANIUM, HASTELLOY, 347 STAINLESS STEEL, AND 6061 T-6 ALUMINUM. Fox, H. A. Jr. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 8p. Dep. NTIS $4.00.

Tests were conducted to determine the interface bond integrity between the test material and the flame sprayed aluminum. The materials considered were 347 stainless steel, Hastelloy C, and 304 stainless steel that are used for the TIL, PDL, and DL respectively. Because of the similarity of 347 snd 304 stainless steels, only 347 was tested. Type 6AL–4V titanium was also included in this test since it is a primary candidate for the NERVA pressure vessel. Additional tests were also conducted on 6061 T-6 aluminum. Since sheathed cables must be mechanically attached to surfaces in a manner which will prevent movement during the subsequent grit blasting and flame spraying operations, additional tests were made to determine a suitable method of cable attachment to these materials. All methods and procedures previously conducted for flame spraying aluminum to aluminum proved satisfactory for the base materials under consideration. A 0.010-in. thick, 347 stainless steel, U shaped weld-clamp was used to replace the aluminum clamp and, when resistance welded, was found to be suitable for use on Hastelloy, titanium, and stainless materials. (auth)

26305 (TID/SNA-435) SELECTION OF BRAZING PROCESS FOR NERVA-ENGINE SKIRT-DEVELOPMENT PROGRAM. Technical Report. Materials, W142-03. Spaletta, H. W. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 50p. Dep. NTIS $5.50.

The development of furnace brazing procedures for proposed NERVA (Nuclear Engine Rocket Vehicle Applications) AISI 347 skirts is described. Braze alloy selection based on the results of metallographic examination, fabrication of specimens, and review of current literature is presented. Results of the test program using vertical flow specimens, brazed Titan tube specimens, and fabrication of a simulated full scale skirt assembly indicate that an acceptable skirt can be assembled using Palniro-7 (70 Au–8 Pd–22 Ni) for the first braze cycle and Nioro (82 Au–18 Ni) for the second cycle. (auth)

26306 (TID/SNA-1087) CAST ALUMINUM ALLOY JACKET MATERIALS DEVELOPMENT PROGRAM FOR THE NERVA NOZZLE. Second Summary Status Report, 4–30 November 1962. Technical Memorandum No. 158 LRP. Inouye, F. T. (Aerojet-General Corp., Sacramento, Calif. (USA)). 28 Mar 1963. 44p. Dep. NTIS $5.25.

Four small experimental brazed Type 347 CRES tube bundles were electroplated with Au, Ni, Ag, and Cu, and then diffusion-treated in hydrogen. They were jacketed with A-356 aluminum alloy using the static melt consolidation process, and examined. Au and Ag were most effective in conferring a metallurgical bond between the braced tube bundle and cast aluminum alloy jacket. Gold is considered superior to silver as the primer on the basis of observed bonding continuity. Metallurgical bonding was not evident between those bundles primed with Ni and Cu respectively and their cast aluminum alloy jackets. (auth)

26307 PRODUCTION OF HIGH-PURITY INDIUM. Bronnikov, A. D.; Vasilevskaya, I. I.; Nisel'son, L. A.; Nikolaev, R. K.; Smirnov, V. A. Izv. Akad. Nauk SSSR, Metal.; No. 4, 54-57(1974). (In Russian).

A study was made of a process of producing high-purity indium according to the scheme: synthesis and purification of InCl by rectification on a quartz column; zone purification of InCl; isolation of indium by the disproportionation of InCl; vacuum melting and zone purification of metallic indium. The high efficiency of the method is demonstrated. Purity control was carried out from the ratio of indium resistivity (β) at room and helium temperatures. Indium metal was obtained with β values of 30,000 at 4.2°K and 80,000 at 3.4°K. (SJR)

26308 A METHOD FOR OBTAINING PURE BORON AND DEVICE FOR CARRYING OUT SAID METHOD. Naslain, R. R.; Soum-Pouyalet, B. G.; Etourneau, J. R.; Hagenmuller, P. J. (to Agence Nationale de Valorisation de la Recherche (ANVAR), 92-Paris-Defense (France)). French Patent 2178799/A/. 7 Apr 1972. 21p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A combination of reducible boron is reduced by means of hydrogen in the gaseous-phase, at a temperature of from about 1000°C to about 1100°C, in a vertical reactor comprising a bed of porous boron pellets maintained in the fluidized state by the reaction gaseous mixture. The boron thus obtained is quite pure. Said method can be applied to the preparation of pure boron in the state of porous, and chemically highly reactive, pellets. (FR)

26309 WELDING OF AN ADVANCED HIGH STRENGTH Ti ALLOY. Greenfield, M. A. (Air Force Materials Lab., Wright-Patterson AFB, OH); Duvall, D. S. Weld. J. (N. Y.); 54: No. 3, 73s-80s(Mar 1975).

From 55th annual meeting of the Welding Research Council; Houston, TX (6 May 1974).

Many recently developed high strength titanium alloys do not possess the inherent good weldability of previous alloys in this material system. Difficulties have been encountered in achieving satisfactory weldment mechanical properties in several of these alloys. An investigation was conducted to study the metallurgical response of one of these materials, Ti-6246, to arc welding. The goal was to identify the causes for inferior properties in advanced titanium alloy weldments and to provide guidelines for improved processing procedures to correct welding difficulties. Gas tungsten-arc welds made on 0.125 in. thick sheet were evaluated metallographically and with hardness, bend, and tensile tests to characterize their properties in the aswelded condition and after various postweld heat treatments. Gleeble synthetic heat-affected zone specimens were utilized to more fully study this weldment region. These tests revealed that the weld and near heat-affected zone regions were extremely hard and brittle as welded and after a normal postweld stress relief. Studies showed that this was caused by rapid auto-aging of an orthorhombic martensite phase formed during the weld thermal cycle. Solution heat treating after welding removed the orthorhombic martensite but failed to substantially improve weld ductility. Films of alpha phase precipitated at prior beta grain boundaries during the solution heat treatment were responsible for the low weld ductility in this condition. Based upon these results, a new postweld heat treatment was established which successfuly increased weld ductility by favorably altering the weld and heat-affected zone alpha precipitation. This approach and others suggested by this investigation appear to be promising methods for improving the weldability of advanced titanium alloys. (auth)

26310 PREPARATION OF STEPPED W SINGLE CRYSTAL SURFACES. Butz, R.; Krahl-Urban, B.; Preuss, E.; Bruchmann, D. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (a); 27: No. 1, 205-212(16 Jan 1975).

Tungsten single crystal surfaces oriented at a small angle with respect to a low-indexed plane can show a terraced structure characterized by flat terraces of the low-indexed plane with monatomic steps at equal distances. Stepped surfaces can play an essential role in surface processes (adsorption, catalysis). A method is described how stepped tungsten single crystal surfaces can be prepared with an accuracy of better than 15′ in orientation, an overall flatness of better than $1/10$ of a wavelength of the Na–D line, a surface roughness of smaller than 0.05 μm, and without destruction detectable by LEED. (auth)

26311 P/M LITERATURE REFERENCE GUIDE. A Bibliography of Powder Metallurgy Literature Published from 1946 Through 1972. 1st Edition, 1974–1975. Princeton, NJ; Metal Powder Industries Federation (1974). 207p.

Powder metallurgy references are indexed according to subject, author, and publication. Major subject headings are: (1) compacting; (2) sintering; (3) secondary operations; (4) powder processes; (5) testing/quality; (6) properties/applications; (7) materials; and (8) materials (cont.)/markets. Most publications in this guide are available for purchase from the American Powder Metallurgy Institute/Metal Powder Industries Federation. (PMA)

26312 HOT SPINNING Ti PRESSURE VESSELS CUT COSTS, IMPROVE PROPERTIES. Mikol, V. P. (TRW Inc., Redondo Beach, CA). Metal Progr.; 107: No. 3, 74-77(Mar 1975).

Ti pressure vessels, fabricated by hot spinning, showed higher fatigue strength, better stress-corrosion resistance, lower cost, and decreased fabrication time, when compared with forged products. Fatigue tests were performed in air for both weld

and base metal; MMH (monomethylhydrazene) and N_2O_4 formed the propellant used for the stress-corrosion tests. Fracture toughness values obtained were 45,300 $\psi\sqrt{\text{in.}}$ (1570 MPa $\sqrt{\text{mm}}$) for the base metal and 36,200 $\psi\sqrt{\text{in.}}$ (1260 MPa $\sqrt{\text{mm}}$) for the weld metal. (PMA)

26313 POWDER METALLURGY OF HIGH-STRENGTH Ti ALLOYS. Friedman, G. (Nuclear Metals Inc., Concord, MA). Metal Progr.; 107: No. 3, 81-84(Mar 1975).

A rotating electrode process was developed for producing high purity powders of reactive metals. The rotating electrode (material to be powdered) is rotated in a He filled, circular chamber, while molten metal is produced on its surface by an electric arc. Centrifugal force causes the molten metal to fly off in the form of fine droplets that freeze in flight into spherical microcastings as they fall to the floor of the chamber. (PMA)

26314 MATERIALS AND PROCESSES FOR SPACE SHUTTLE'S ENGINES. Lewis, J. R. (Rockwell International, Canoga Park, CA). Metal Progr.; 107: No. 3, 41-51(Mar 1975).

The processing, fabrication techniques, and applications of various alloys used in the construction of the Space Shuttle Main Engines are summarized. The list of alloys includes inconel, stainless steels, beryllium copper, Ti-Al-V alloys, and other nickel, cobalt, iron, titanium, copper, silver, and gold based materials. (PMA)

Properties, Structure, and Phase Studies

Refer also to abstracts 25333, 25717, 26243, 27492, 27493, 27499, 28279, 28321, 28324, 28325, 28434, 28444, 28574, 28653, and 28657.

26315 (AD-784925) VIBRATION-ABSORBING PROPERTIES OF STRUCTURAL MATERIALS. Pisarenko, G. S.; Yakovlev, A. P.; Matveev, V. V. 2 Apr 1974. Translation of Vibroprogloshchayushchie Svoistva Konstruktsionnykh Materialov, Kiev, 1971. (FSTC-HT-23-1485-73). 490p. NTIS $27.50.

A reference book is presented containing data on the vibration-absorbing properties of materials for turbine blades and aircraft. It is based on investigations conducted in the Ukrainian Academy of Sciences and the Kiev Polytechnical Institute. Information is included on the dissipation of energy in materials, methods for determining characteristics of energy dissipation during vibrations, and descriptions of testing devices. Information is also included in the forms of tables and graphs for different types of vibrations for alloys and steels. (GRA)

26316 (AD-785421) ELECTRONIC STRUCTURE OF HARD SUPERCONDUCTORS. Final Report. Spicer, W. E.; McMenamin, J. C.; Lindau, I. (Stanford Univ., Calif. (USA). Stanford Electronics Labs.). 31 Aug 1974. 9p. (AFOSR-TR-74-1374). NTIS $3.00.

The work on MoS_2 has contributed strongly to major revisions of the widely accepted band models for the layered dichaldogenides. Work on Nb, determining the electronic structure, and establishing procedures for cleaning the surface, has been completed. Preliminary data on high transition temperature alloys have been obtained. The development of a technique for cleaning Nb makes it possible to perform meaningful studies on high temperature Nb based superconductors. (auth)

26317 (AED-CONF-74-538-025) PRACTICAL EXPERIENCE AND FUNDAMENTAL EXAMINATION TO AVOID STRESS RELIEF CRACKING IN THE HEAT-AFFECTED ZONE OF NUCLEAR CONSTRUCTION STEELS. Dittrich, S.; Grosse-Woerdemann, J.; Hauck, G. (Westfaelische Union A. G., Hamm (F. R. Germany)). 1974. 13p. (In German). INIS.

From second international colloquium: welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

Known reasons are reviewed for stress relief cracking, influence of precipitations and non-metallic inclusions, relaxing of the welding deposit, reduced crack sensitivity by improving the behavior of relaxation. (auth)

26318 (AGC-2275(Vol.4)(Pt.1)) MANUAL OF MATERIALS DATA RELEASE MEMORANDA. Part I. DRM 01 Through 04. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1971. Contract SNP-1. 346p. Dep. NTIS $20.50.

Data on NERVA reactor materials are presented. Information is included on Inconel 718, stainless steels, Al-base alloys, and Ti-base alloys. (JRD)

26319 (AGC-2275(Vol. 4)(Pt.2)) MANUAL OF MATERIALS DATA RELEASE MEMORANDA. Part II. DRM 05 Through 23. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1971. Contract SNP-1. 302p. Dep. NTIS $18.25.

Data are presented on NERVA reactor materials. Information is included on alloy A-286, Al-base alloys, Ti-base alloys, stainless steels, friction properties, and steels. (JRD)

26320 (BNL-50363) QUARTERLY PROGRESS REPORT ON HIGH CYCLE FATIGUE OF LMFBR MATERIALS, APRIL 1-JUNE 30, 1972. Gurinsky, D. H. (Brookhaven National Lab., Upton, N. Y. (USA)). 1972. Contract AT(30-1)-16. 25p. Dep. NTIS $4.25.

Research on properties of LMFBR materials is reported. Information is included on fatigue of 304 stainless steel, Incoloy 800, and 2¼ Cr-1 Mo steel. Results of studies on the effects of C content on these materials are given along with results of studies on effects of environment and effects of thermal aging. (JRD)

26321 (COO-1198-1109) NUCLEAR MAGNETIC RESONANCE STUDY OF DILUTE COPPER-VANADIUM ALLOYS. Follstaedt, D. M. (Illinois Univ., Urbana (USA)). Jan 1975. Contract AT(11-1)-1198. 167p. Dep. NTIS $11.50.

Thesis.

Nuclear magnetic resonance (NMR) was used to study dilute alloys of copper with vanadium impurities. NMR is well-suited to studying the nearly insoluble vanadium atoms as the measurements are not affected by the presence of undissolved vanadium. The isotopes ^{51}V, ^{63}Cu, and ^{65}Cu nuclear resonances were used to obtain information on the relative amounts of dissolved and undissolved vanadium, on the magnetic nature of the dissolved vanadium atom, on the magnetization of the copper host in the vicinity of this dissolved atom, and on the electric field gradients produced in the host when the atom is dissolved. In two samples with vanadium concentrations of .045 and .275 at. %, the actual dissolved concentrations are estimated to be ~.036 and ~.190 at. %, respectively. These are obtained by observing the intensities of the ^{51}V resonances from vanadium atoms dissolved in copper and from the pure metal atoms which did not dissolve. The Knight shift of the dissolved ^{51}V resonance is +.14 ± .02% at 4.2°K, and increases to +.21 ± .02% at 300°K. Estimated characteristic temperatures for the impurity susceptibility are θ = 1100, 4300°K for quadratic and Curie-Weiss forms of temperature dependence. These are approximately the same as obtained for Cu-Co and are larger than that of Au-V (θ = 290°K), in agreement with current theoretical understanding of magnetic impurities. An assumed copper satellite has been observed to have a magnetic splitting at high fields (up to 58 kgauss) with a splitting relative to the pure copper Knight shift given by $\Delta K/K = -.662 \pm .015$. It is thought to be due to copper nuclei which are second nearest neighbors to dissolved vanadium atoms. A magnetization broadening of the ^{63}Cu main line at 58 kgauss was also observed. The sizes of the broadening and of the satellite splitting suggest that the copper magnetization around dissolved vanadium atoms is similar to Cu-Co, in agreement with current theoretical ideas. Low-field (<10 kgauss) satellite studies give a second-order quadrupole satellite, believed due to first neighbor copper nuclei to dissolved vanadium atoms. Its quadrupole coupling constant is estimated to be $\nu_Q \sim 3.7$ Mc. First order quadrupole satellites with smaller couplings were also observed; they are believed due to more distant (5-9th) neighboring shells. It is concluded that the magnetic nature of vanadium atoms in copper is similar to that of cobalt, but the electric fields are much stronger around vanadium atoms. (auth)

26322 (COO-3150-32) ELECTRON SPIN RESONANCE. Progress Report. Bowers, R.; Silsbee, R. H. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). 1975. Contract AT(11-1)-3150. 11p. Dep. NTIS $4.00.

The scattering of conduction electrons by rare earth magnetic ions (Gd, Dy, Th, Er, Yb, and Lu) in Al was studied using the transmission electron spin resonance technique. Also studied was exchange scattering in Cu-Fe. Electromagnetic acoustic wave generation (EAG) was observed in Al films of zero field. Moderately pure metals on an insulating substrate were found to be efficient transducers from 100 to 1000 MHz. Results are to be published on the thermal magnetoresistance of potassium and on EAG results for the type II superconducting alloys, Pb-In and Nb-Mo. The radio frequency size-effect in potassium was examined. (PMA)

26323 (COO-3158-38) FIELD ION MICROSCOPE STUDIES OF SOLUTE ATOMS IN DILUTE PT ALLOYS. II. Distributions and Interactions of Au and Ni Atoms. Report No. 2344. Chen, C. G.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y. (USA)). Dec 1974. Contract AT(11-1)-3158. 25p. Dep. NTIS $4.25.

Previous work (Part I) has established that the position of each Au and Ni solute atom in dilute solution in Pt can be identified in the field ion microscope (FIM) as an α-dark spot. In the present work the exact positions of large numbers of solute atoms in the lattice were first determined from measurements of α-dark spot positions on ciné films which were taken during the pulsed field evaporation of several dilute binary alloys in the FIM. From these data, radial distribution functions were generated, and solute-solute interaction energies up to 9th nearest-neighbors

were calculated using the Clapp-Moss model. Heats of mixing were then calculated from the interaction energies. The research was aided by specially developed computer techniques which included displaying the solute atom distributions in a rotatable coordinate system. The results indicate clustering of Au atoms and ordering (anti-clustering) of Ni atoms as expected generally from previous thermodynamic data. The calculated heats of mixing were generally consistent with measured values. It was concluded that the FIM can be used, under appropriate conditions, as an effective tool for studying solute atom distributions. (auth)

26324 (COO-3476-8) DISLOCATION INTERACTIONS. A Short Course Given at International School of Physics, Varenna, Italy, July 8–20, 1974 on Atomic Structure and Mechanical Properties of Metals. Bilello, J. C. (State Univ. of New York, Stony Brook (USA). Dept. of Materials Science). 1974. Contract AT(11-1)-3476. 116p. Dep. NTIS $9.00.

Subject material includes: (1) elastic deformation; (2) general features of dislocations; (3) dislocation interactions with localized obstacles; (4) dislocation damping; and (5) dislocation interactions with interfaces. Topics selected are restricted to those which do not appear in standard textbooks, and those which appear particularly stimulating. Attention is focused on detailed discussions of a few problems, rather than a comprehensive review. (PMA)

26325 (INR-1435/14/R) THERMAL CYCLING OF ALUMINUM AND SOME ALUMINUM CANNING ALLOYS. Seyna, F. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 19p. INIS.

From Polish–Italian seminar on some chemical, ceramic, and metallurgical aspects of nuclear fuels; Zakopane, Poland (29 May 1970).

Permanent deformation and microstructural changes in Al and Al–Ni–Fe were studied as a function of: (1) amplitude; (2) holding time at a maximum temperature; (3) slow and fast cooling and heating; and (4) the initial state of the material. Changes in hardness of Al–Mg–Si were examined for a small number of thermal cycles. (auth)

26326 (NRL-Report-7853) X-RAY-LINE-PROFILE ANALYSIS OF TITANIUM ALLOYS. Metzbower, E. A. (Naval Research Lab., Washington, D. C. (USA)). 4 Feb 1975. 15p. Naval Research Lab., Washington, DC.

Detailed measurements of x-ray line broadening were made on: (1) Ti–Al alloys (4, 6, and 9 wt% Al) with varying oxygen content (~0.08, 0.15, and 0.33 wt%); (2) pure Ti samples (0.01, 0.12, and 0.3 wt% oxygen); (3) Ti–6Al–4V alloys (0.05, 0.11, and 0.15 wt% oxygen); and commercially available Ti alloys (Ti–7 Al–2 Nb–1 Ta, Ti–5 Al–2.5 Sn, Ti–7 Al–12 Zr, and Ti–4 Al–3 Mo–1 V). Transmission electron microscopy was used to correlate these data with measurements of the stacking fault probability. The results obtained indicate that: (1) The increase in stacking fault probability in Ti can explain the morphology of the dislocation arrays in these alloys; (2) The effect of oxygen in Ti–Al alloys is not synergistic in changing the stacking fault probability and the corresponding dislocation structures; (3) No correlation is evident between oxygen concentration and susceptibility to stress corrosion cracking in the 6Al–4V alloys; and (4) The four commercial alloys examined show a correlation between stacking fault probability and susceptibility to stress corrosion cracking. (PMA)

26327 (RDT-M-2-19-T(2-75)) 2¼% CHROMIUM, 1% MOLYBDENUM ALLOY STEEL TUBESHEET FORGINGS (ASME SA-336 WITH ADDITIONAL REQUIREMENTS). (USERDA Technical Information Center, Oak Ridge, Tenn.). Feb 1975. 10p. RSO.

A standard prescribing requirements for 2¼% Cr, 1% Mo alloy steel tubesheet forgings (ASME SA-336 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2-19T, dated May 1974. (JRD)

26328 (RDT-M-5-22T(2-75)) 2¼% CHROMIUM, 1% MOLYBDENUM ALLOY STEEL PLATES (ASME SA-387 WITH ADDITIONAL REQUIREMENTS). (USERDA Technical Information Center, Oak Ridge, Tenn.). Feb 1975. 8p. RSO.

A standard prescribing requirements for 2¼% Cr, 1% Mo alloy steel plates (ASME SA-387 with additional requirements) for nuclear and associated applications is presented. (JRD)

26329 (RP-SR-0002(Appx.A,B,C,D,E)) PHOEBUS-2 MATERIALS FINAL REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 335p Dep. NTIS $19.75.

Metallurgical testing conducted in support of the Phoebus 2 nozzle program is documented. The tensile properties of forgings, strip, weldments, and brazements are presented as individual test data and as statistical means with sigma limits through the temperature range of −423 to 1800°F. The mechanical property values of shear strength, bearing strength, low-cycle fatigue, and thermal cycling are also presented. In addition, the manufacturing and fabrication processes from raw material melting through fabrication of individual hardware components are described. Metallurgical analysis of thermal treatments and processing are also provided. (auth)

26330 (SAND-74-8664) COMPUTERIZED PREDICTION OF THE PHASE DIAGRAM FOR THE TERNARY SYSTEM Be–Fe–Al. Baskes, M. I. (Sandia Labs., Livermore, Calif. (USA)). Feb 1975. Contract AT(29-1)-789. 19p. Dep. NTIS $4.00.

The phase stability of the Be–Fe–Al ternary system was calculated over the entire composition range and for temperatures between 1000K and 1800K. Gibbs free energy functions were calculated for seven phases over this same range of composition and temperature. Experimental information used in these calculations consists of the binary phase diagrams and thermodynamic data. Interactive graphics computer codes were developed to fit the experimental data with the free energy model and also to calculate and display isothermal sections. (auth)

26331 (SAND-75-6004) STUDY OF PHASE TRANSFORMATIONS IN TITANIUM ALLOYS. III. Study of the Transformations of the Beta III Titanium Alloy Under Isothermal Conditions. Vial, F.; Beauvais, C.; Fidelle, J. P.; Hocheid, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). Feb 1975. Translation of CEA-R-4567. 41p. Dep. NTIS $5.25.

Phase transformations of a new metastable alloy, β III Ti (Ti–11 Mo–6 Zr–4.5 Sn) have been studied using: (1) dilatometry; (2) metallography; (3) x-ray crystallography; (4) hardness testing; and (5) resistivity measurements during heating. TTT curves (time, temperature, transformation) were obtained for isothermal holding at various temperatures. (PMA)

26332 (TID/SNA-420) NERVA MATERIALS PROGRAM PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 18 Feb 1972. 11p. Dep. NTIS $4.00.

Data on Nerva reactor materials are presented. Information is included on stainless steels, Hastelloy, steels, Ti-base alloys, graphite, and Inconel. (JRD)

26333 (TID/SNA-513) MANUAL OF MATERIALS DATA RELEASE MEMORANDA, s131-DRM08-W187f4. Supplement I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1971. 58p. Dep. NTIS $6.00.

Data tables are presented for the fatigue properties of annealed Ti–5Al–2.5Sn (ELI), fatigue and mechanical properties of annealed-aged and solution treated-aged A-286, and mechanical properties of irradiated (fast neutrons) AG Carb-101 composite. (DLC)

26334 (TID/SNA-514) MANUAL OF MATERIALS DATA RELEASE MEMORANDA, s131-DRM08-W187f4. Supplement I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1971. 62p. Dep. NTIS $6.25.

Data are presented on NERVA reactor materials. Information is included on Ti–5Al–2.5Sn alloy, Alloy A-286, and AG Carb-101 composite material. (JRD)

26335 (TID/SNA-515) MANUAL OF MATERIALS DATA RELEASE MEMORANDA, s131-DRM08-W187f4. Supplement II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1971. 43p. Dep. NTIS $5.25.

Data tables are presented of: fatigue of Alloy 718; mechanical properties (compression yield strength and elastic modulus, Poisson's ratio, hardness, density) of AISI 440C; tensile ultimate strength (notched) of AISI 9310, phosphor bronze, and Alloy 22-13-5; thermal conductivity of Alloy 22-13-5; and tensile properties of fast neutron-irradiated Alloy 22-13-5. (JRD)

26336 THE ELECTRICAL RESISTIVITY OF RARE EARTH METALS AT HIGH TEMPERATURES AND IN THE LIQUID STATE. Guentherodt, H. J.; Hauser, E.; Kuenzi, H. U. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkoerperphysik). Phys. Lett., A; 50: No. 4, 313-314(11 Dec 1974).

The values of the electrical resistivity of rare earth metals in the liquid state are compared to their corresponding values at low temperatures. In the liquid state the electrical resistivity of the rare earth metals increases nearly linearly across the rare earth series from La to Er. This is contrary to the behavior at room temperature, where the resistivity of the rare earth series has a maximum for Gd. (auth)

26337 X-RAY PHOTOELECTRON STUDIES OF PURE AND OXIDIZED YTTERBIUM AND LUTETIUM. Lang, W. C.; Padalia, B. D.; Fabian, D. J.; Watson, L. M. (Strathclyde Univ., Glasgow (UK)). J. Electron Spectros. Relat. Phenomena; 4: No. 5, 207-215 (Nov 1974).

From international conference on electron spectroscopy; Namur, Belgium (16 Apr 1974).

X-ray photoelectron spectra of pure and deliberately oxidized ytterbium and lutetium were investigated with a high-vacuum instrument (VG-ESCA3), using both aluminium and magnesium Kα radiation. Core-level binding energies are measured accurately with respect to the Fermi level of the pure metal and discrepancies were found between the present and previously published data. Precise information regarding the location of 4f-levels with respect to the Fermi level was obtained. The splitting of the 4f levels was observed and yields some interesting information. The results were compared with those available from theoretical and other experimental reports. (auth)

26338 MEETING ON MOLYBDENUM IN SPECIAL STEELS, PARIS, FRANCE, NOVEMBER 29, 1973. Mater. Tech.; 62: 1-127 (Mar 1974). (In French).

The papers deal with weakly alloyed steels with high mechanical characteristics for use at low temperatures; high-elastic-limit weldable steels weakly alloyed with Mn, Mo, and Nb; and the influence of an intercritical treatment on the brittleness of a Ni–Cr–Mo–V rotor steel. Attention is also given to the development of weakly alloyed molybdenum steel powders for forged parts, the influence of molybdenum on the resistance to pitting corrosion and contact corrosion of austenitic stainless steels, and the mechanism of the action of molybdenum in the corrosion resistance of austenitic stainless steels. Other papers describe a new stainless ferritic steel with 18% Cr and 2% Mo, and deal with high-chromium-content ferritic steels containing molybdenum, and the use of molybdenum steels in helicoidal drills with fluid circulation holes for cooling of cutting ridges. (IAA)

26339 DAMPING AND ELASTIC CHARACTERISTICS OF PLASMA-SPRAYED COATINGS OF TUNGSTEN, NICHROME, ZIRCONIA, AND CHROMIUM–NICKEL SPINELS. Zolotukhin, I. V.; Akinin, K. G.; Abramov, V. V.; Netusov, Yu. K.; Skorobogatov, V. S.; Svedomtsev, N. V. (Voronezh Pedagogical Inst., USSR). Strength Mater. (USSR) (Engl. Transl.); 5: No. 9, 1120-1123(Jun 1974).

26340 THERMODYNAMIC CONSTANT OF MUTUAL SOLUBILITY OF METALS IN EQUILIBRIUM. Osipov, K. A. (Moscow Inst. of Metallurgy). Dokl. Akad. Nauk SSSR; 217: No. 6, 1362-1365(21 Aug 1974). (In Russian).

The mutual solubility thermodynamic constant was calculated on the basis of the eutectic or peritectic temperature and the concentration of the solvent at the eutectic or peritectic point for a number of binary systems including Ag–Cd, Ag–In, Ni–In, Ni–Nb, Ni–V, Ni–W, Au–Cd, Au–In, Cu–Cd, Cu–In, and Zn–Cd. (JSR)

26341 STATISTICAL CHARACTER OF MAGNETIC PROPERTIES OF SINGLE-CRYSTAL PARTICLES IN HIGHLY ANISOTROPIC FERROMAGNETICS. Kandaurova, G. S.; Deryagin, A. V.; Lagutin, A. E. (Ural State Univ., Sverdlovsk, USSR). Phys. Status Solidi (a); 27: No. 2, 429-440(16 Feb 1975).

Magnetization reversal processes of single-crystal particles in $SmCo_5$ and $GdCo_5$ alloys were studied by observing the domain structure by means of Kerr-magnetooptic effect. The influence of different factors on the coercivity H_c and stability of the single-domain particle state was investigated. When the number of observed particles is large and the measurements are performed repeatedly, some general regularities can be found, such as a rise in H_c with an increase in amplitude of the magnetizing field to 17 kOe or with the decrease in particle size from 300 to about 10 μm, and a fall in H_c with increasing temperature from −130 to +320°C. A rise in H_c of particles at room temperature results in an increase in their single-domain temperature stability. The theoretical dependence of H_c on the magnetizing field is calculated on the assumption of pinning in displacement of residual domain boundaries on structure defect clusters. The statistical character of observed regularities in changes of magnetic properties of particles is emphasized. (auth)

26342 DO_{22} INTERMEDIATE PHASE IN THE Ni–Mo SYSTEM. Van Tendeloo, G.; De Ridder, R.; Amelinckx, S. (Rijksuniversitair Centrum, Antwerp). Phys. Status Solidi (a); 27: No. 2, 457-468(16 Feb 1975).

A study of Ni_2Mo by electron microscopy and electron diffraction reveals the presence of a new metastable intermediate phase during the early stages of ordering. This phase having the DO_{22} structure is only observed under well specified experimental conditions; it is generated immediately from the short range ordered state. The presence of this intermediate phase could be expected from a theoretical point of view, since none of the well known ordered phases as Ni_4Mo, Ni_3Mo, or Ni_2Mo may form immediately from the f.c.c. high temperature phase. The DO_{22} phase is described here as an intermediate step in the quite complicated formation of ordered Ni_3Mo. (auth)

26343 QUENCHING STUDIES OF VACANCY-IMPURITY INTERACTIONS IN CADMIUM. Simon, J. P.; Hillairet, J. (CEN, Grenoble, France). Phys. Status Solidi (a); 27: No. 2, 533-541 (16 Feb 1975). (In French).

Vacancy–impurity interactions were studied in dilute cadmium alloys by means of electrical resistivity measurements after quenching down to liquid helium temperature. Highly soluble impurities like Ag, Mg, Zn do not show attractive interactions with vacancies: by contrast, most low solubility elements, like Fe, Si, Sn lead to large effective binding energies. These activation energies cannot be interpreted in the frame of elementary vacancy–impurity interactions, but rather in terms of clustering effects, which appear to occur for the lowest impurity levels of some atomic parts per million. (auth)

26344 DISLOCATION BEHAVIOR IN PURE NIOBIUM AT LOW TEMPERATURES. Ikeno, S.; Furubayashi, E. (National Research Inst. for Metals, Tokyo). Phys. Status Solidi (a); 27: No. 2, 581-590(16 Feb 1975).

Foils of niobium single crystals with [110] (001) orientation were deformed in tension at −100°C inside a 500 kV electron microscope, and the behavior of individual dislocations was studied by means of a VTR system. Screw dislocation mobility was determined by the density of superjogs caused by cross slip or cutting. Probabilities of dislocation multiplication, cutting, and debris formation during 0.1% plastic strain were measured for three mean velocities of screw dislocations. The frictional stress for ideally straight edge dislocations in niobium was estimated to be 10% of flow-stress, which was significantly larger than that in iron. (auth)

26345 THERMODYNAMIC STUDY OF THE REACTION OF GADOLINIUM WITH LEAD. Roshchina, V. R.; Bayanov, A. P. Izv. Akad. Nauk SSSR, Metal.; No. 4, 183-187(1974). (In Russian).

Measurements were taken on the emfs of galvanic cells of the concentration type. The studies were carried out in the temperature interval from 773 to 879°K and at gadolinium contents of 0.66 to 10.6 at.% in the alloys. The thermodynamic properties of $GdPb_3$ and of its solutions in liquid lead were investigated in the polythermal and isothermal variants. The Gibbs free energy and enthalpy and entropy of formation were determined, and the partial molar thermodynamic characteristics of gadolinium in the liquid alloy were calculated. Activity coefficients of $GdPb_3$ and its solubility in liquid lead were determined. The very low values of the activity coefficients and negative values of other thermodynamics characteristics of gadolinium in liquid lead indicate the formation of different groups of atoms in solution, whose number is determined by a statistical distribution. (SJR)

26346 CONCENTRATION DEPENDENCE OF LATTICE CONSTANTS IN Ni–La ALLOYS. Dvorovenko, N. A.; Zeidlits, M. P.; Sirenko, G. A.; Khotkevich, V. I. Izv. Akad. Nauk SSSR, Metal.; No. 4, 175-177(1974). (In Russian).

X-ray changes in Ni–La alloys were followed on a diffractometer. The concentration dependence of the lattice periods in the Ni–La alloys showed that the limiting solubility of lanthanum in nickel was 0.07 at.%. The method of Vegard was used to calculate the lattice constants in Ni–La alloys corresponding to the existence of a true solid solution. Agreement between calculated and experimental values of lattice constants is good except when the concentration of La exceeds the limiting solubility, whereupon a sharp divergence occurs. (SJR)

26347 POLYGONIZATION DURING CREEP OF MOLYBDENUM-BASED ALLOYS. Zasimchuk, E. E.; Marushi, O. I. Izv. Akad. Nauk SSSR, Metal.; No. 4, 157-161(1974). (In Russian).

A number of recent studies have been carried out to determine substructural changes during creep. This study on structural changes during high-temperature creep of single- and polycrystalline, slightly-alloyed molybdenum showed that in both cases processes responsible for accelerating the deformation have one and the same physical nature. Polygonization, which develops at the stage of established creep, leads to recrystallization of macrovolumes of metal, localization of the deformation, and rupture. Consequently the resistance of molybdenum alloys to deformation at high temperatures is determined by the rate of occurrence of recrystallization annealing processes. (SJR)

26348 EFFECT OF ARGON ON THE HEAT STRENGTH OF TUNGSTEN WIRE. Aleksandrov, L. N.; Mordyuk, V. S.; Sinitsyn, G. F. (Izv. Akad. Nauk SSSR, Metal.; No. 4, 137-142(1974). (In Russian).

A substantial decrease in the durability of tungsten wire samples was observed at high temperatures in an inert atmosphere as compared with vacuum testing. By the method of least squares an activation energy was determined for the long-term failure of tungsten in an atmosphere of argon. Within the limits of experimental error this activation energy coincides with the activation energy for the diffusion of inert gas atoms in a metal. The long-term

failure of tungsten in an inert medium is connected with the penetration of inert gas atoms into the body of the metal, coagulation of the inert gas, and the formation of gas cavities at the grain boundaries, as confirmed by metallographic studies and internal friction data. (SJR)

26349 ELECTROCHEMICAL INVESTIGATIONS ON SOLID STATE DIFFUSION: ADSORPTION AND ALLOY FORMATION IN THE SYSTEM GOLD/CADMIUM. Schultze, J. W.; Koppitz, F. D.; Lohrengel, M. M. (Freie Univ. Berlin (F.R. Germany). Inst. fuer Physikalische Chemie und Quantenchemie). Ber. Bunsenges. Phys. Chem.; 78: No. 7, 693-701(Jul 1974). (In German).

10 figs.; 1 tab.; 34 refs.

At gold electrodes the adsorption kinetics of cadmium ions and the formation of Au/Cd-alloys were investigated by means of combined potentiostatic/potentiodynamic measurements in a solution of 0.1 m cadmium sulphate and 1 m acetate buffer at potentials more positive than the reversible cadmium potential ϵ_{Cd}. Since the adsorption of cadmium ions is relatively fast, the rate determining step of alloy formation must be a place exchange reaction of cadmium and gold atoms in the solid. From the temperature dependence of the current density, an apparent activation energy of about 22 kcal/mole is obtained. On the other hand the anodic dissolution of the alloy depends mainly on the potential difference alloy/electrolyte and on the surface concentration of the alloy. The results are discussed in relation to thermodynamic and kinetic data of Au/Cd-alloys. (GE)

26350 MEASURING THE DENSITY OF LIQUID METALS BY MEANS OF GAMMA RADIATION. Yavoiskii, V. I.; Ezhov, A. A.; Kravchenko, V. F.; Uskov, V. S.; Neboosov, Yu. I.; Chernov, Yu. A.; Dorofeev, G. A. Izv. Akad. Nauk SSSR, Metal.; No. 4, 61-66(1974). (In Russian).

Measurements of the density of liquid metals at high temperatures were carried out by gamma radiation. Radioactive ^{137}Cs was used as the source of radiation. Estimates are given of possible errors in measuring the density of metals, which occur because of sample curvature, a change in metal composition, a change in scattered radiation, etc. The measurements were rather accurate with a relative error of 0.2%. The densities of copper and iron were established as a function of temperature from the melting point to 1600 and 1720°C respectively. A change in specific volume of copper and iron was found at the crystallization point. (SJR)

26351 EFFECT OF ZIRCONIUM ON THE PHASE COMPOSITION OF THE ALLOY Nb-W-Zr-Ta-C. Kuz'minskaya, L. N.; Sosulina, I. A. Izv. Akad. Nauk SSSR, Metal.; No. 4, 223-224(1974). (In Russian).

The introduction of zirconium into the alloy Nb-W-Zr-Ta-C has a substantial effect on its phase composition. In an alloy without zirconium and with 0.8 wt % Zr a niobium carbide β-Nb_2C is formed; at a zirconium content of 2.91% a carbide MeC and nitride ZrN are formed. A further increase of zirconium content in the alloy to 5.0 wt % leads to an increase in the amount of zirconium nitride ZrN and to enrichment of the MeC phase in niobium. On going from these data and from comparative estimates of the efficiency of strengthening different types of niobium alloys with carbides it can be concluded that alloying of Nb-W-Ta-C alloys with zirconium is desirable and that it is necessary to introduce more than 0.8 wt % zirconium. (SJR)

26352 PHASE EQUILIBRIA IN ALLOYS OF Mg-Nd-Y-Zn. Drits, M. E.; Padezhnova, E. M.; Miklina, N. V. Izv. Akad. Nauk SSSR, Metal.; No. 4, 218-222(1974). (In Russian).

By the methods of metallographic analysis a study was made of alloys in the Mg-Nd-Y-Zn system at 500, 300, and 200°C, containing up to 4% Nd, 12% Y, and 8% Zn. In the concentrated region of alloys in equilibrium with an alpha--magnesium solid solution the following phases can be found: Mg_9Nd, $Mg_{24}Y_5$, MgZn, X ($MgNd_2Zn_3$), Y($Mg_3Nd_2Zn_7$), Z($Mg_3Nd_2Zn_3$), and also V and W, ternary phases of the Mg-Y-Zn system. The region of solid solutions on magnesium as a base has six points of common solubility of neodymium, yttrium and zinc, which correspond to the following equilibria: $\alpha_1 \rightleftharpoons Mg_9Nd + Mg_{24}Y_5 + V$; $\alpha_2 \rightleftharpoons Mg_9Nd + X + V$; $\alpha_3 \rightleftharpoons X + V + W$; $\alpha_4 \rightleftharpoons X + Y + W$; $\alpha_5 \rightleftharpoons Y + Z + W$; $\alpha_6 \rightleftharpoons MgZn + Z + W$. (SJR)

26353 STUDY OF THE Zr-Ni-Ga AND Zr-Cu-Ga SYSTEMS. Markiv, V. Ya.; Storozhenko, A. I. Izv. Akad. Nauk SSSR, Metal.; No. 4, 213-217(1974). (In Russian).

An x-ray and partial microstructural study was carried out on the Zr-Ni-Ga and Zr-Cu-Ga systems in the cast state and in the annealed state at 800°C (with subsequent quenching). Isothermal cross-sections of the phase diagrams of Zr-Ni-Ga and Zr-Cu-Ga were constructed at 800°C. In both systems at 800°C a large number of ternary phases are formed (16 in the Zr-Ni-Ga system and 8 in the Zr-Cu-Ga system), which contain as a base up to 33.3 at.% Zr. For a number of ternary phases the type of crystal structure was established: $AuCu_3$ (A-Zr_3NiGa_8, a = 4.027 Å; A-Zr_3CuGa_8, a = 4.067 Å), $MnCu_2Al$ (H-$ZrNi_2Ga$, a = 6.103 Å), and Th_6Mn_{23} (T-$Zr_6Cu_{12.8}Ga_{10.1}$, a = 12.11 Å). (SJR)

26354 PHASE EQUILIBRIA IN V-Nb-Cr ALLOY. Fedotov, A. K. Izv. Akad. Nauk SSSR, Metal.; No. 4, 207-212(1974). (In Russian).

A study was made of phase equilibrium in the V-Nb-Cr system at temperatures of 1000 and above 1400°C. Regions of the existence of ternary solid solutions (α) and of a Laves phase (β) were determined. The microhardness of the β-phase in cast and annealed alloys varied with composition from 600 to 700 and 1000 to 1030 kg/mm². The maximum value of microhardness corresponds to an alloy 32.5 at.% V, 34.7 at.% Cr and 32.8 at.% Nb. The lattice constant of the ternary Laves phase $Nb(V,Cr)_2$ of stoichiometric composition increases linearly from 6.992 Å for $NbCr_2$ to 7.135 Å for a composition Nb $(V_{0.75}Cr_{0.25})_2$. From data on lattice constants and microhardness of the α- and β-phases a determination was made of the direction of tie lines in the heterogeneous region of the ternary system V-Nb-Cr. (SJR)

26355 TEMPERATURE DEPENDENCE OF MAGNETIC EXCITATIONS IN SINGLET-GROUND-STATE SYSTEMS. II. Excited-State Spin Waves Near the Curie Temperature in Pr_3Tl. Buyers, W. J. L.; Holden, T. M.; Perrault, A. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Phys. Rev., B; 11: No. 1, 266-277(1 Jan 1975).

A theory was developed of the temperature dependence of the spin waves in a system involving transitions between all levels of the ground multiplet of an ion. The excitations out of both ground and excited states are described by the product of annihilation and creation operators for the single-ion states of the crystalline field and molecular field. The spin-waves are obtained with the random-phase approximation applied to the interlevel transition operators rather than to S_z as in conventional spin-wave theory. Numerical results were obtained for Pr_3Tl that agree with the neutron measurements of Birgeneau and coworkers. There is little variation with temperature through the phase transition of the scattering from modes having wave vectors greater than $(0.25,0.25,0)2\pi/a$. This is partly because the measurements average over two groups of spin waves that interact the spin waves out of the ground state and the excited-state spin waves corresponding to the $\Gamma_4 \rightarrow \Gamma_3$ transition. The $\Gamma_1-\Gamma_4$ zone-center modes are strongly temperature dependent but do not go soft. They decrease in frequency as T rises from zero to T_c by factors of ~4 and ~6 for S_z and S_x modes, respectively. Very-low-frequency transverse (S_x) modes (~0.02 THz) appear at elevated temperatures and do go soft as $T \rightarrow T_c$. These modes correspond to transitions between the states of the weakly exchange-split Γ_4 triplet. (7 fig.) (auth)

26356 METALLURGICAL STRUCTURE AND SUPERCONDUCTING BEHAVIOR OF Zr-Nb BINARY ALLOYS. Narasimhan, S. L. Seattle; Univ. of Washington (1974). 282p. University Microfilms Order No. 75-4023.

Thesis (Ph. D.).

The superconducting phase transition behavior of zirconium base Zr-Nb alloys has been correlated with their constitution and the microstructural modifications resulting from various thermal and mechanical treatments. The products of beta decomposition through a phase separation process, athermal and isothermal omega reactions and the precipitation of the equilibrium alpha phase, produced prior to and following plastic deformation, have been investigated for their potential flux pinning effects in the superconducting mixed state. Based on the critical state model of flux pinning in superconductors, the critical current densities and the pinning force densities have been determined for the various flux pinning agents observed. Superconducting transitions were monitored by an inductance technique and magnetization measurements at 4.2°K were made in persistent magnetic fields obtained with a superconducting solenoid. Structural and microstructural correlations were obtained using x-ray and transmission electron microscopy techniques. The observation of a double superconducting transition and a broadening of the transition that occurred during the precipitation of the omega phase in a Zr-15 at. % Nb alloy led to the conclusion that the nature of the superconducting transition is a sensitive function of the structure and composition modulations in hard superconductors. The isothermal omega phase, by virtue of its low T_c, lowers the bulk T_c of the Zr-15 at. % Nb alloy. The bulk T_c could be raised to a value above that of the as quenched alloy by an upquenching treatment to revert the omega phase. The composition modulations introduced by the reversion treatment exhibited potential flux pinning characteristics. Isothermal aging at 550°C for 175 hours increases

the value of the T_c of a Zr–15 at. % Nb alloy from 6.82°K for in the as quenched alloy to 10.2°K for the aged alloy containing the alpha phase. The as-quenched Zr–Nb alloys containing athermal omega phase exhibited an almost completely reversible magnetization behavior at 4.2°K. The absence of flux pinning in such alloys has been attributed to the size of the athermal omega particles which are smaller than the coherence length of the as quenched Zr–Nb alloys. Precipitation of isothermal omega particles at 350°C in the size range of 150 to 450Å offered the most effective flux pinning in Zr–15, 20 and 26 at. % Nb alloys. The alpha phase particles are observed to be less effective flux pinners than the omega particles. Electron microscopy revealed the occurrence of a phase separation reaction in a Zr–20 at. % Nb alloy at temperatures below the monotectoid temperature of 610°C. Such a mode of beta decomposition occurs through the precipitation of disclike β_1 particles exhibiting the same bcc structure as the matrix. Subsequent nucleation of the omega phase occurs at the interface between β_1 particles and the matrix. Plastic deformation is observed to strain-induce athermal omega phase in a Zr–20 at. % Nb alloy and accelerates the precipitation of the isothermal omega phase, thereby suppressing the phase separation reaction. Niobium lean regions resulting from a phase separation reaction following omega phase reversion, have been identified unambiguously by dark field electron microscopy. A significant contribution to pinning and high critical current densities (7×10^4 A/cm^2 at 15 kilogauss) has been observed to result from the precipitation of the β_1 particles. The omega particles that precipitate during continued aging consume the β_1 particles and increase the critical current densities to 2×10^5 A/cm^2 for the same field, but at the expense of flux stability. Flux instabilities are observed in the form of abrupt and complete flux jumps at discrete values of the applied field in Zr–15, 20 and 26 at. % Nb and Ti–20 at. % V alloys containing the omega phase. Such instabilities are attributed to the heating effects arising from normal currents induced in the omega particles during the transients in the applied field. The weakly superconducting β_1 precipitates appear to be attractive from the standpoint of obtaining optimum critical currents with maximum stability. The occurrence of a peak effect in the form of double maxima in the magnetization behavior of a Zr to 15 at. % Nb alloy has been attributed to the shielding effects arising from the niobium rich regions surrounding the omega particles in this alloy. It has been established that the peak effect is sensitive to the omega particle size and the extent of solute enrichment of the matrix, which can be modified by suitable double aging treatments. Dislocations introduced by plastic deformation have been observed to enhance flux pinning in Zr–20 at. % Nb alloy. The precipitation of the isothermal omega phase in the Zr–20 at. % Nb alloy, initially deformed to 90% reduction in thickness and aged at 350°C for 30 minutes, raises the upper critical field of the alloy from 40 kilogauss to 70 kilogauss. A concomitant enhancement is also observed in the flux stability and the magnitude of the critical currents. The results and conclusions of the investigation emphasize the potential importance of constitutional and microstructural control, using multiple thermal and mechanical treatments for the purpose of maximizing critical transport currents and flux stability in superconducting Zr–Nb alloys. (Diss. Abstr. Int., B)

26357 MICROSTRUCTURE AND MECHANICAL PROPERTIES OF Cr–Mo STEELS. Chalco, P. A. Los Angeles; Univ. of California (1974). 274p. University Microfilms Order No. 75-1973.

Thesis (Ph. D.).

The correlation between microstructure as a function of carbon content and heat treatment and mechanical properties of 2–1/4 Cr–1Mo steels was studied using three 2–1/4Cr–1Mo steels of different carbon content, namely, Alloys L (0.009% C), I (0.03% C), and H (0.12% C). The microstructural studies included: optical metallography, thin-film TEM and x-ray diffraction of extracted residues. The evaluation of mechanical properties included room temperature tensile testing and creep testing at 850 to 1050°F. In the normalized condition, Alloys L and I contained equal amounts of regular and irregular ferrite, and 80% regular ferrite and 20% bainite, respectively. Alloy H contained mostly bainite. The regular ferrite contained a uniform dispersion of precipitates, identified as CrN in Alloy L; the irregular ferrite was heavily dislocated, the bainite was of the granular type. When the normalized alloys were tempered at 1300°F for 1 hour (N & T), the regular ferrite remained basically unchanged, while extensive dislocation recovery and subgrain formation occurred in the irregular ferrite. In the bainite, extensive dislocation recovery occurred also, together with heavy carbide precipitation. Subsequent tempering at 850, 950, and 1050°F for 1 to 19 months caused some changes in the microstructure. The irregular ferrite disappeared completely after 4 months at 850°F but it gradually recrystallized at 950 and 1050°F. The regular ferrite remained basically unchanged at 850 and 950°F, but precipitation of M_3C needles occurred at 1050°F. The bainite remained basically unchanged at 850 and 950°F, but at 1050°F the M_3C needles disappeared completely and only coarse carbides and subgrains remained. In tensile testing, it was found that Alloy H showed the highest yield strength, followed by Alloys L and I, in the normalized condition. In the N&T condition, the yield strength of Alloys H and L decreased, while that of Alloy I increased. When the N&T materials were tempered at 850, 950, and 1050°F for up to 19 months, the yield strength of Alloy H remained constant at 850 and 950°F, but it decreased steadily at 1050°F. In Alloy I, its yield strength decreased sharply after 1 month of tempering at 950 and 1050°F, remaining basically unchanged at longer tempering times. At 850°F the yield strength of Alloy I decreased more steadily. In Alloy L, a steady decrease in strength was observed at all temperatures, but at 950°F a secondary hardening effect was found after long periods of time. Based on the microstructural studies, the strengthening contributions to the yield strength were analyzed and found to be due mainly to dislocations, second phase particles, grain boundaries and subgrain boundaries. The first three were evaluated in terms of classical alloy strengthening theories, but subgrain strengthening could not be accounted for by existing theories. In this case, a model is proposed, in which subgrain boundary strengthening is additive to grain boundary strengthening. This model was substantiated by experiment. The results of creep testing indicated that in the 930 to 1050°F temperature range, the activation energy for creep, Q_c, is approximately the same as the activation energy for self-diffusion, Q_d, while at 850 and 890°F, Q_c was found to be much larger than Q_d. Also, at high stresses, the observed high values of the stress exponent, n, and Q_c cannot be explained by any of the existing creep theories, while at intermediate stresses, the rate controlling mechanism of creep appears to be the climb of dislocation loops pinched off around particles as proposed by Ansell and Weertman. At low stresses, the data was insufficient to determine the operating creep mechanism, but it was found that all the proposed creep mechanisms (for low stress creep), with the exception of Herring-Nabarro creep, can be operative in this stress range. (Diss. Abstr. Int., B)

26358 EFFECT OF CHEMISTRY VARIATIONS ON THE RECRYSTALLIZATION TEMPERATURE OF 20% COLD-WORKED TYPE 316 STAINLESS STEEL. Paxton, M. M.; Straalsund, J. L. (Hanford Engineering Development Lab., Richland, WA). Nucl. Technol.; 25: No. 3, 546-552(Mar 1975).

The effect of composition on the 1-, 100-, and 1000-h recrystallization temperature of 20% cold-worked Type 316 stainless steel was determined by using hardness measurements. The study was performed on 45 different alloys, based on Type 316 stainless steel; compositional variations were in carbon, nitrogen, phosphorus, sulfur, boron, manganese, copper, silicon, molybdenum, cobalt, chromium, and nickel. Relatively minor compositional changes can markedly increase or decrease cold-work stability. (auth)

26359 THERMOMECHANICAL PROCESSING OF A NICKEL-BASE SUPERALLOY BY COLD-ROLLING AND SHOCK-WAVE DEFORMATION. Meyers, M. A. Denver; Univ. of Denver (1974). 234p. University Microfilms Order No. 75-4182.

Thesis (Ph. D.).

The potential of thermomechanical processing of Inconel 718 by shock-wave deformation was assessed by subjecting it to pressures up to 510 kbar in the solution-treated condition and applying the two standard heat treatments. The introduction of a pre-deformation aging treatment promoted a further increase in strength. The pre- and post-deformation agings were optimized. A systematic determination of long- and short-term tensile properties of the optimized schedule was conducted. The results are interpreted in terms of grain morphology, deformation substructure, precipitate morphology and distribution, annealing response, thermal stability, work hardening and fracture characteristics. (Diss. Abstr. Int., B)

26360 DOMAIN STRUCTURE OF HIGHLY ANISOTROPIC MULTIAXIAL RARE EARTH COMPOUNDS RFe_2. Kandaurova, G. S.; Deryagin, A. V.; Lagutin, A. E. (Ural State Univ., Sverdlovsk, USSR). Dokl. Akad. Nauk SSSR; 219: No. 2, 320-322(11 Nov 1974). (In Russian).

The domain structure of $DyFe_2$ and $ErFe_2$, which are multiaxial ferromagnets with easily magnetized axes of the ⟨100⟩ and ⟨111⟩ type respectively, was studied. The observation of the domain structure of the highly anisotropic cubic ferromagnetics showed characteristics of the domain structure which distinguished them from highly anisotropic uniaxial and low-anisotropic multiaxial

ferromagnets. After electropolishing the fine surface layers remain homogeneously magnetized whereas in the volume of the crystallite magnetization domains appear. (JSR)

26361 DISTRIBUTION OF TUNGSTEN BETWEEN THE METAL, SLAG, AND GAS PHASE ON MELTING FAST-CUTTING STEELS. Chuiko, N. M.; Zaozernyi, N. T. Izv. Akad. Nauk SSSR, Metal.; No. 6, 20-25(1974). (In Russian).

Studies on the oxidation of fast-cutting steels show that the main losses of tungsten take place during melting of the charge and are caused by evaporation of WO_3. A linear dependence was established between the tungsten losses (P_W, %) and the basicity of the slag (B): $P_W = 4.75$ B. Here B is the sum of the mole fractions of CaO and MgO minus the mole fraction of Al_2O_3 divided by the mole fraction of SiO_2 in the slag. In order to decrease the tungsten losses it is necessary to work with slags having a basicity less than 1.0. Equilibrium characteristics of tungsten are determined as a function of temperature. Activity coefficients are determined for various slag components. (SJR)

26362 EFFECT OF YTTRIUM ON THE PROPERTIES OF THE STEELS 40L AND Cr18Ni9L. Etelis, L. S.; Gladkov, M. I.; Ryabova, D. Z.; Kurteev, E. N. Izv. Akad. Nauk SSSR, Metal.; No. 6, 172-174(1974). (In Russian).

Modification of the steels 40L and Cr18Ni9L with optimal amounts of yttrium (0.1 to 0.2 wt %) leads to substantial improvement in the plasticity and viscosity of cast steel with no practical change in strength. An increase in the amount of yttrium which is introduced to 0.5% leads to a deterioration in the mechanical properties of these steels. Additions of yttrium change the form of nonmetallic inclusions and decrease the amount of inclusions in the steel. In steel 40L modified with an optimal amount of yttrium, grain growth begins at 950 to 1000°C, while in steel without yttrium, grain growth is noted at 900°C. Yttrium has a positive effect on the fluidity of liquid steel. With optimal additions of yttrium in steels 40L and Cr18Ni9L the fluidity increases by 10 and 30% respectively above the initial value. (SJR)

26363 STRUCTURE OF EUTECTIC, PSEUDOBINARY ALLOYS OF TRANSITION METALS CONTAINING INTERSTITIAL PHASES. Shurin, A. K.; Barabash, O. M.; Dmitrieva, G. P.; Panarin, V. E.; Legkaya, T. N. Izv. Akad. Nauk SSSR, Metal.; No. 6, 183-187(1974). (In Russian).

A study of microstructure is presented for cast, pseudobinary, eutectic alloys of the following systems: V–ZrO_2, V–HfO_2, Nb–ZrO_2, Nb–HfO_2, V–TiN, V–HfN, Fe–ZrC, Fe–HfC, Co–ZrC, Co–HfC, Ni–ZrC, Ni–HfC, Mo–TiC, Mo–ZrC, Mo–HfC, W–TiC, W–ZrC, W–HfC, Cr–ZrC, Cr–HfC, Fe–TiB_2, Fe–ZrB_2, Cr–ZrB_2, and Cr–HfB_2. The content of interstitial phase in these alloys was 15 to 30 mol %. From a study of the microstructure of these systems it was established that: (1) the eutectic in these alloys consists of columns; (2) column growth begins with the appearance of a nuclei of the interstitial phase; (3) the nuclei grow out to crystals of a critical size which are determined by the composition and rate of cooling during crystallization and which have a form corresponding to its crystal lattice; (4) on attaining a critical size, platelets or rods are formed as branches on the crystallite surrounded by a metal phase, which also are eutectic columns; and (5) the structure of the eutectic columns depends not so much on the nature of the components (metal-interstitial phase), as on the composition of the alloys and the conditions of crystallization. (SJR)

26364 MECHANICAL PROPERTIES OF TITANIUM ALLOYS CONTAINING BETA-STABILIZERS. Mikheev, V. S.; Levanov, V. I.; Kheifits, S. I.; Chernitsyn, A. I. Izv. Akad. Nauk SSSR, Metal.; No. 6, 203-205(1974). (In Russian).

Composition-mechanical properties diagrams are constructed for three sections of the Ti–V–Nb, Ti–V–Mo and Ti–V–Nb–Mo system. Alloys of the Ti–V–Nb system have properties with the highest plasticity, while alloys of systems containing molybdenum have the highest strength properties with a sufficient reserve of plasticity. On the basis of an analysis of the plastic characteristics of the alloys and x-ray analysis, a region for the existence of an ω-phase in these alloys was established. From the results it is possible to select alloys with a given level of properties at +20 and –196°C. (SJR)

26365 PHASE DIAGRAM AND A NUMBER OF PROPERTIES OF Ti–Zr–Cr ALLOYS. Musaev, R. S.; Kornilov, I. I.; Belousov, O. K. Izv. Akad. Nauk SSSR, Metal.; No. 6, 211-214 (1974). (In Russian).

By high-temperature, contact-free thermal analysis, the liquidus diagram was constructed for the Ti–Zr–Cr system. It was established that eutectic equilibria of the Zr–Cr system (liq $\rightleftharpoons$ β_{Zr} + ZrC_2 and liq $\rightleftharpoons$ β_{Cr} + ZrC_2) in the ternary system are closed along the line of a secondary eutectic. The temperature of eutectic equilibria in the ternary system is lowered by formation of a temperature minimum at the point k having a composition of 45% Ti, 25% Zr and 30% Cr. The binary eutectic crystallization curve and the peritectic curve corresponding to the conversion liq + δ $\rightleftharpoons$ γ intersect at an invariant point p with a composition of 46% Ti, 8% Zr and 46% Cr. The conversion temperature is 1350 ± 20°C. Three regions of primary crystallization exist in the Ti–Zr–Cr system: β, δ and γ. A study of the mechanical properties of Ti–Zr–Cr alloys showed that alloys of a section having a zirconium to chromium ratio of 5 to 1 possessed optimal properties of strength and plasticity. An alloy of this section with 1% (Zr + Cr) has high strength and plasticity at a temperature of liquid nitrogen: σ = 100 to 105 kg/mm² and δ = 39 to 40%. (SJR)

26366 PHASE DIAGRAM OF THE Zn–Cd–Hg SYSTEM. Nosek, M. V.; Atamanova, N. M. Izv. Akad. Nauk SSSR, Metal.; No. 6, 215-219(1974). (In Russian).

From data of differential thermal, x-ray phase and microstructural analyses, and also from measurements of the hardness of a number of alloy samples, the melting diagram of the Zn–Cd–Hg system was constructed. The following invariant, peritectic equilibria were established in the system: Cd + liq $\rightleftharpoons$ ω + (Zn) (160 ± 2°C), (Zn) + liq $\rightleftharpoons$ γ + ω (~20°C), γ + liq $\rightleftharpoons$ β + ω (~0°C), ω + L $\rightleftharpoons$ (Hg) + β (–38 ± 0.5°C), and also transition of an unordered ω-phase to an ordered phase at –15 ± 2°C. (SJR)

26367 STUDY OF PLASTIC DEFORMATION OF SINGLE-CRYSTAL TERBIUM. Chupyatova, L. P.; Chuprikov, G. E.; Prokhorova, O. N. Izv. Akad. Nauk SSSR, Metal.; No. 6, 158-160(1974). (In Russian).

The distinguishing feature of single-crystal terbium, in comparison with other hexagonal close-packed (hcc) metals, is its increased tendency to twinning over a wide region of orientations. In spite of the small value of the c/a ratio, a basal glide is observed in the large part of the standard triangle of a crystal sample. Prismatic glide which is accompanied by strong strengthening and a small increase in length is observed only in crystals with an orientation near the basal plane. (SJR)

26368 MECHANISM OF THE PLASTIC DEFORMATION OF SINGLE-CRYSTAL (001) [110] MOLYBDENUM DURING ROLLING. Goncharov, V. A.; Karpov, M. I.; Kopetskii, Ch. V.; Pronina, L. N. Izv. Akad. Nauk SSSR, Metal.; No. 6, 122-132(1974). (In Russian).

A study is carried out of the effect of temperature and the amount of reduction per pass during rolling on the change in form, the dislocation structure, and texture of single-crystal molybdenum (001)[110] after rolling and after subsequent annealing. An increase in reduction per pass leads to an increase in fraction of glide in the {110} planes, an increase of dislocation density in the deformed and annealed state, and does not change the general, chaotic distribution of dislocations in the metal. An increase in rolling temperature to 500°C leads to a well-formed, cell, dislocation structure in the (001)[110] single-crystal of molybdenum, and to subsequent recrystallization during annealing. It was confirmed that a condition leading to recrystallization during annealing was the presence of a cellular dislocation structure in the metal. (SJR)

26369 EFFECT OF MOLYBDENUM ON THE THERMODYNAMIC ACTIVITY OF CARBON IN NICKEL–MOLYBDENUM ALLOYS. Gernets, L. V.; Golovanenko, S. A.; Svistunova, T. V.; Tomilin, I. A. Izv. Akad. Nauk SSSR, Metal.; No. 6, 76-81(1974). (In Russian).

Carbon activity coefficients were determined in nickel alloys containing up to 24 at. % Mo in the temperature interval of 900 to 1300°C. Molybdenum contents up to 13.2 at. % Mo can increase the thermodynamic activity of carbon in Ni–Mo alloys, while molybdenum contents from 19.3 to 24.2 at. % Mo decrease the carbon activity. The activity coefficient of carbon is given as a function of temperature. The value of the carbon activity coefficient for an alloy with 3.3 at. % Mo depends slightly on the temperature. For alloys with 6.6, 10.0 and 13.2 at. % Mo the carbon activity coefficient decreases with increasing temperature. (SJR)

26370 ELECTRICAL RESISTANCE OF NIOBIUM, TANTALUM, MOLYBDENUM, AND TUNGSTEN AS A FUNCTION OF ENTHALPY. Martynyuk, M. M.; Tsapkov, V. I. Izv. Akad. Nauk SSSR, Metal.; No. 6, 63-67(1974). (In Russian).

In the temperature interval of 298 to 1400°K for Mo and 298 to 1950°K for W, the electrical resistance is a linear function of the enthalpy, and for Nb and Ta in the interval from 298°K to $T_{melt.}$, the electrical resistance is a non-linear function of the enthalpy. This behavior is explained by the predominance in increase of the heat capacity over the temperature coefficient of resistivity of Nb and Ta. The ratio of the resistance of the liquid and solid phases at $T_{melt.}$ for Nb, Ta, Mo, and W is much less than the value calculated from the formula of Mott. (SJR)

26371 MECHANISM OF MODIFYING VACUUM-MELTED MOLYBDENUM WITH BORON. Chernov, V. S.; Busol, F. I.; Nam, B. P. Izv. Akad. Nauk SSSR, Metal.; No. 6, 116-121(1974). (In Russian).

It is shown that a mechanism of modification based on the formation of additional crystallization on refractory inclusions is highly improbable in electro-beam-melted molybdenum containing boron. A presentation is given of theoretical (from the generalized momentum, the statistical generalized momentum and atomic volume) and experimental (by the hanging drop method) estimate of the surface activity of boron and carbon in molybdenum. It is shown that boron and carbon are surface-active additives in molybdenum. The modifying effect of boron on molybdenum is explained by starting from the concept of the occurrence of a boron concentration gradient before the crystallization front. The result is a slowdown in the growth of molybdenum crystals and to the appearance of a concentration supercooling. (SJR)

26372 SUPERCONDUCTIVE PROPERTIES OF $Nb_{12}Al_3Ge$ WITH VARIABLE NIOBIUM CONTENT. Ageev, N. V.; Alekseyevskii, N. E.; Shamray, V. F. pp 17-19 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoystvami. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Studies were done on the critical temperature, the critical magnetic field and substructure of the compound $Nb_{12}Al_3Ge$ in ternary alloys of the niobium-aluminum-germanium system with ratio of the atomic concentration of aluminum to germanium of 3:1, maximum niobium content of 78 at. %, and minimum niobium content of 69 at. %. It was found that a surplus of niobium relative to the stoichiometric composition of $Nb_{12}Al_3Ge$ causes a reduction in the critical temperature of $Nb_{12}Al_3Ge$, diffusion of the curve for transition to the superconductive state and reduction of the critical magnetic field. A surplus of aluminum and germanium does not cause an abrupt change of superconductive properties. The reduction of superconductive parameters in alloys with excess niobium content is attributed to a change in the state of the substructure of the compound of $Nb_{12}Al_3Ge$. (3 figures, 4 references) (auth)

26373 PRESSURE ENHANCED SUPERCONDUCTIVITY IN $NbSe_2$. Smith, T. F. (Univ. of California, La Jolla, San Diego); Shelton, R. N.; Schwall, R. E. J. Phys., F (London); 4: No. 11, 2009-2016(Nov 1974).

The pressure dependence of the superconducting transition temperature for the layer compounds $2H\text{-}Nb_{1+x}Se_2$ (x = 0, 0.01, 0.02, 0.05 and 0.1) and 4H-$NbSe_2$ has been investigated to 25 kbar. A strong enhancement of T_c is observed. A brief discussion of the influence of pressure upon the band structure and its relationship to the change in T_c is given. (auth)

26374 INFLUENCE OF Mn IMPURITIES ON THE RESISTIVE TRANSITION OF QUENCH-CONDENSED SUPERCONDUCTING Pb FILMS. Kawaguti, T.; Shibuya, Y. (Kyushu Univ., Fukuoka). Phys. Lett., 50A: No. 2, 103-104(18 Nov 1974).

The observed excess conductivity due to fluctuations of quench-condensed Pb films with Mn impurities is smaller than that given by the Fulde-Maki theory. This supports the result that the Pb-Mn system shows a deviation from the Abrikosov-Gor'kov theory. (auth)

26375 EFFECTS OF SULFUR CONTENT ON SUPERCONDUCTIVITY AND INTERCALATION IN TRANSITION METAL DISULPHIDES. Thompson, A. H. (Exxon Research and Engineering Co., Linden, NJ). Nature (London); 251: No. 5475, 492-494(11 Oct 1974).

It is stated that the nearly two-dimensional character of the Group IVB and VB transition metal dichalcogenides intercalated with organic molecules makes them good choices for the study of superconductivity in two dimensions. The study has been restricted, however, by the quality of available crystals — many of these complexes are metastable at room temperature, and others deintercalate below 150°C. Many intercalation compounds also become exfoliated, so that measurements on single crystals become difficult. Other crystals show little or no registry between adjacent layers. It has been found, however, that addition of S both orders and thermally stabilizes the complex. Some experimental work is described with Ta S_2 crystals. It was found that intercalation with pyridine from a saturated solution with S produced a material of greater thermal stability, with less disorder, and little or no exfoliation. The presence of S also influences the electronic and magnetic properties of intercalation complexes, including the superconducting transition temperature. Similar results were obtained with TaS_2 and TiS_2 intercalated with aniline. In some cases polysulphide chains may form on the organic chain. (UK)

26376 THE INFLUENCE OF SODIUM/WATER FLAMES ON THE FATIGUE ENDURANCE OF AISI 316 STAINLESS STEEL. Marshall, P.; Newman, R. N.; Smith, C. A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). J. Nucl. Mater.; 54: No. 2, 346-348(Dec 1974).

The fatigue properties of thin AISI 316 stainless steel strips following exposure to sodium/water flames are reported. The results are interpreted using EPMA, SEM, optical metallography, and a theoretical fatigue model. (auth)

26377 THE VACANCY FORMATION ENERGY FOR ZIRCONIUM. Antonini, M.; Bortolani, V. (Comitato Nazionale per l'Energia Nucleare, Ispra (Italy)); Bertoni, C. (Modena Univ. (Italy). Istituto di Fisica). J. Nucl. Mater.; 54: No. 2, 258-264(Dec 1974).

The vacancy formation energy of zirconium was calculated by means of a microscopic model which takes into account the electron-electron and electron-ion interaction. The result obtained is in reasonable agreement with the presently available experimental data. The connections between the vacancy formation energy and the basic mechanisms for irradiation creep in this material are discussed. (auth)

26378 SILVER DIFFUSION IN ZIRCONIUM. Tendler, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Departamento de Metalurgia); Varotto, C. F. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). J. Nucl. Mater.; 54: No. 2, 212-216(Dec 1974).

The diffusion coefficients of Ag in both α and β phases of Zr are reported. The temperature dependence of the diffusion coefficients may be expressed by $D_{\alpha\text{-}Zr}^{Ag(110)} = 5.1 \times 10^{-3}$ exp(-44700/RT) cm^2/sec and $D_{\beta\text{-}Zr}^{Ag(110)} = 5.7 \times 10^{-4}$ exp(-32700/RT) cm^2/sec and is strongly dependent on the phase transition. The general diffusion behavior is analyzed in terms of the Hägg and the Anthony and Turnbull rules, indicating that Ag diffuses as substitutional in Zr. (auth)

26379 THE CREEP STRENGTH OF QUENCHED AND AGED Zr-2.5 WT % Nb ALLOY. Fidleris, V. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). J. Nucl. Mater.; 54: No. 2, 199-211(Dec 1974).

The creep at 573 and 723 K of quenched and aged Zr-2.5 wt % Nb alloy was studied as a function of solution temperature in the range 1073 to 1273 K, oxygen concentration in the range 170 to 1150 ppm, and ageing at 673 or 773 K. The microstructures of the creep specimens permitted a qualitative correlation of structural information with the results of the creep tests. It is concluded that the creep strength of the quenched and aged Zr-2.5 wt % Nb alloy is largely dependent on the amount of α-Zr phase, the oxygen concentration in the martensitic α' phase and the distribution of homogeneously nucleated matrix precipitates in the martensitic α' phase. (auth)

26380 PRODUCTION OF ZIRCONIUM α MONOCRYSTALS AND THE STUDY OF THEIR CRYSTALLINE PERFECTION. Braichotte, G.; Couterne, J. C. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Lab. de Metallurgie); Cizeron, G. (Paris-11 Univ., 91 - Orsay (France)). J. Nucl. Mater.; 54: No. 2, 175-189(Dec 1974). (In French).

The methods depending on critical straining followed by α-phase annealing, or on thermal cycling across the allotropic transformation temperature, do not enable the production of large zirconium crystals of predetermined orientation. A method based on localized phase transformation in a controlled thermal gradient was successfully developed: it permits the preparation of crystals up to 100 mm long in favorable cases. A study of the mechanism of formation of an α monocrystal from a β monocrystal has led to a recognition of the parameters which determine the growth of the desired monocrystals. An analysis of the crystal orientations obtained has established the optimal conditions for obtaining orientations close to a desired one. X-ray methods were used to examine the perfection of the crystals: some were strongly polygonized but others had overall misorientations of less than 10^{-2} degree. (auth)

26381 AN ELECTRON PROBE MICROANALYSIS OF THE PLUTONIUM-TIN ALLOY SYSTEM. Wallace, P. L.; Harvey, M. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). J. Nucl. Mater.; 54: No. 2, 171-174(Dec 1974).

The electron microprobe was used to determine the chemical composition of six intermetallic phases that exist in the plutonium-tin binary alloy system. The phases are tentatively identified as $PuSn_2$, Pu_7Sn_3, Pu_5Sn_3, Pu_2Sn_3, Pu_3Sn_4, and Pu_2Sn. The results are compared with the extremely similar plutonium-lead alloy system. (auth)

26382 NUCLEAR γ RESONANCE STUDY OF THE STATE OF THE ^{119}Sn NUCLEUS IN SUPERCONDUCTING Nb-BASED COM-

POUNDS. Gruzin, P. L.; Bychkov, Yu. F.; Evstyukhina, I. A.; Alekseev, L. A. pp 12-16 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (Ed.). Moscow; Adomizdat (1974). (In Russian).

^{119}Sn in intermetallic compounds of the Nb–Sn system, primarily the Nb-based solid solution with 0.5% Sn and the compounds Nb_3Sn, Nb_6Sn_5, and $NbSn_2$ was studied by nuclear γ resonance. Data showed that the probability of the Moessbauer effect changes sharply with temperature, indicating that the lattice phonon spectrum is displaced to low frequencies and is easily excited during change of temperature. The Debye temperature decreased with increase of the Sn concentration, which is connected to the decrease of the strength of Sn bonds with neighboring compounds. The compounds from α-Nb to $NbSn_2$ become very loose with respect to the bonding strength. The γ resonance spectra of the compounds studied showed that with increase of the Sn concentration, the density of 5s electrons in ^{119}Sn nuclei increased which decreased the ionicity of the chemical bonds of the Sn. Large gradients of the electric field in Sn nuclei were observed in Nb_6Sn_5 and $NbSn_2$ because of the nonspherical distribution of the electron charge. A clear temperature dependence of the probability of the Moessbauer effect in ^{119}Sn was characteristic for the compounds studied. This is connected with the low lying branch of the oscillations easily excited with temperature. (JSR)

26383 KINETIKA I TERMODINAMIKA VZAIMODEISTVIYA GAZOV S ZHIDKIMI METALLAMI. (Kinetics and Thermodynamics of the Interactions of Gases with Liquid Metals. Conference Held in Moscow, USSR, October 17–19, 1972). Ageev, N. V. (Ed.). Moscow; Izdatel'stvo Nauka (1974). 208p. (CONF-7210128-).

A compilation is presented of studies dealing with the interaction of oxygen, nitrogen, and hydrogen with liquid metals, degasification of liquid steel, control of the degree of oxidation of liquid steel, and industrial method of metal refining. Separate abstracts were prepared for two articles. (JSR)

For abstracts of individual papers see: 26301 and 26384.

26384 SOLUBILITY OF HYDROGEN IN BINARY COPPER-BASED ALLOYS. Linchevskii, B. V.; Degtyarev, Yu. V.; Chursin, V. M. pp 15-20 of Kinetika i Termodinamika Vzaimodeistviya Gazov s Zhidkimi Metallami. Ageev, N. V. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

From symposium on kinetics and thermodynamics of the interactions of gases with liquid metals; Moscow, USSR (17 Oct 1972). See CONF-7210128-.

The solubility of hydrogen in liquid Cu and its alloys with Fe, Ni, Co, Cr, Mn, Zn, Sn, Sb, Pb, Si, P, Ti, and V was studied by the Siverts method in the isochoric variation. It was shown that Ni, Fe, Co, Mn, and Cr increase the solubility of hydrogen in Cu, but the other metals decrease it. The parameters of the interaction of hydrogen with the alloying elements in Cu melts were studied. (tr-auth)

26385 MULTIPLET STRUCTURE BELOW "THRESHOLD" IN APPEARANCE–POTENTIAL SPECTRA—LANTHANUM $N_{4,5}$. Smith, R.J.; Piacentini, M.; Lynch, D.W. (Ames Laboratory–USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. Lett. 34: No. 8, 476-479 (24 Feb 1975).

We present the $N_{4,5}$ appearance–potential spectrum of La. Structure exists at energies lower than the threshold energy for transitions terminating at the Fermi level. Several similarities between optical absorption spectra and our results are discussed. These results contradict the simple model usually used to interpret appearance–potential spectra and emphasize the need for a new theory. (auth)

26386 THERMAL DESORPTION OF LANTHANIDE ATOMS FROM THE SURFACE OF TANTALUM. Medvedev, B.K. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Solid State 16: No. 7, 1242-1244 (Jan 1975).

The heats of desorption l_0 and the preexponential factors D in the kinetic equation for the desorption of the atoms of 12 lanthanides from the surface of tantalum have been determined by the method of temperature modulation. A periodicity was found in the relationship between l_0 and the atomic number of the elements. The adsorption bond between the lanthanides and tantalum is considerably weaker than that between the lanthanides and tungsten; this is due to the smaller number of 5d electrons in tantalum that take part in the formation of this bond. (auth)

26387 STUDY OF THE DIFFUSION OF Au AND Ag IN Be USING ION BEAMS. Myers, S.M.; Langley, R.A. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 46: No. 3, 1034-1042 (Mar 1975).

The diffusion of Au and Ag in single–crystal α–Be has been studied using ion beam techniques. The time–dependent diffusion profiles were monitored by ion backscattering. Diffusion couples were created both by ion implantation and by vapor deposition, with consistent results. Diffusion data were obtained at two temperatures, 665 and 780 °C, for both *c* and *a* crystallographic directions. Because of the low solid solubilities of Au and Ag in Be, $\lesssim 0.1$ at.% at the above temperatures, a surface layer of $\sim$ 1000 Å thickness was always present in which the solubility was greatly exceeded. During annealing this layer served as a source from which the solute diffused into the underlying Be. The surface layer was characterized by transmission electron microscopy in the case of Au implantation. No evidence of precipitation was found following the room–temperature implantation, but subsequent annealing above about 300 °C caused regions of $AuBe_5$ to form in the layer. In the underlying bulk, the observed diffusion behavior indicates that the dilute solute is migrating within the α–Be lattice without formation of an intermetallic compound, and that its concentration is limited by the solid solubility. By solving the diffusion equation with appropriate boundary conditions, the diffusion coefficients and solid solubilities in α–Be are extracted. The diffusion rates for Au in Be are found to be very similar to those for Cu in Be in magnitude, in temperature dependence, and in anisotropy ($D_c/D_a \simeq 0.5$ in both cases). However, for Ag the diffusion coefficients are larger by about an order of magnitude and have the opposite anisotropy ($D_c/D_a \simeq 2$). This variation among the I B solutes is shown to correlate with pseudopotential parameters. Diffusion measurements were also made for Au in polycrystalline Be with a mean grain size of 10 μm. This effective diffusion coefficient is found to be much larger than in the single–crystal material, a factor of $\sim$100 at 665 °C, and to have a weaker temperature dependence. (auth)

26388 THERMAL BOUNDARY RESISTANCE (Kapitza resistance) AT INTERFACES BETWEEN COPPER AND TYPE–II SUPERCONDUCTORS. Schmidt, C. (Institut für Experimentelle Kernphysik, Kernforschungszentrum Karlsruhe, Karlsruhe, Postfach 3640, West Germany). J. Appl. Phys. 46: No. 3, 1372-1375 (Mar 1975).

A thermal boundary resistance (Kapitza resistance) occurs at interfaces between two metals if one of these metals is superconducting. Experiments performed on interfaces of Nb–Cu and NbTi–Cu indicated values of the Kapitza resistance which exceeded the prediction based on the acoustic mismatch theory. In light of these studies it is shown that the thermal boundary resistance must not be neglected in the stability considerations of technical multifilament superconductors. (auth)

26389 LOW–TEMPERATURE HEAT–CAPACITY STUDY OF THE $Y_{1-x}Th_xFe_3$ SYSTEM. Kunesh, C.J.; Narasimhan, K.S.V.L.; Butera, R.A. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). J. Appl. Phys. 46: No. 3, 1349-1351 (Mar 1975).

Low–temperature heat–capacity measurements between 1.5 and 10 °K have been made on some compounds in the $Y_{1-x}Th_xFe_3$ system (x=0.1, 0.3, 0.5, 0.7, 0.9, and 1.0). The electronic specific–heat coefficient γ exhibits a maximum at x=0.3. The lattice specific–heat coefficient β increases, while the Debye temperature θ_D decreases with increasing x. The results of this study are in agreement with a model proposed to explain the anomalous magnetic behavior of the $Y_{1-x}Th_xFe_3$ system. The variation of γ as a function of x is discussed in terms of a band model for the 3*d* transition metals. (auth)

26390 MAGNETIC PROPERTIES OF SOME LIGHT RARE–EARTH COMPOUNDS WITH CsCl STRUCTURE. Buschow, K.H.J. (Philips Research Laboratories, Eindhoven, The Netherlands); de Jong, J.P.; Zandbergen, H.W.; van Laar, B. J. Appl. Phys. 46: No. 3, 1352-1354 (Mar 1975).

Neutron–diffraction studies were performed on the compounds PrZn, NdZn, NdMg, and NdAg. The lattice constants were determined at 300 and 4.2 K. For all compounds the CsCl structure was confirmed at room temperature. The compound PrZn was found to be subject to a tetragonal distortion at 4.2 K. A very small tetragonal distortion exists probably also in NdZn and NdMg at 4.2 K. The magnetic moment of the rare–earth component and the magnetic structure type was determined. All compounds are antiferromagnetic at 4.2 K, PrZn and NdMg with the $\langle 0,0,\pi \rangle$ structure, NdAg with the $\langle \pi,\pi,0 \rangle$ structure. In view of the generally accepted explanation of the magnetic properties of CsCl–type intermetallics in terms of the RKKY model these findings for PrZn and NdMg are remarkable and form a discrepancy with the ferromagnetic nature of the heavy rare–earth counterparts of these compounds. (auth)

26391 SOME COMMENTS ON RECENT MEASUREMENTS OF THE PENETRATION DEPTH IN NIOBIUM. Strongin, M.; Varmazis, C. (Brookhaven National Laboratory, Upton, New York 11973). J. Appl. Phys. 46: No. 3, 1401-1402 (Mar 1975).

A discussion is given of some difficulties of interpretation when the apparent superconducting penetration depth is used to infer the mean free path at a metal surface. (auth)

26392 COMMENTS ON DEVIATIONS OF THE PENETRATION DEPTH OF NIOBIUM FROM BCS CALCULATIONS. Halbritter, J. (Institut für Experimentelle Kernphysik, Universität und

Kernforschungszentrum, D 75 Karlsruhe, West Germany). J. Appl. Phys. 46: No. 3, 1403-1404 (Mar 1975).

The temperature and frequency dependences of the magnetic field penetration depth $\lambda(T,\omega)$ of superconducting Nb show deviations from the BCS theory. These deviations are discussed. It is indicated that inhomogeneities in Nb can adequately account for them. (auth)

26393 MAGNETIC PROPERTIES OF THE SUPERCONDUCTING COMPOUND $Mo_3SnGa_{0.5}S_8$. Alekseevskiĭ, N. E.; Bazan, Ch.; Dobrovol'skiĭ, N. M.; Tsebro, V. I. (Institute of Physics Problems, USSR Academy of Sciences). JETP Lett. 20: No. 7, 211-212 (5 Oct 1974).

It is shown that the investigated system has a phase diagram that differs from usual type-II superconductors in that strong paramagnetism (ferromagnetism) coexists with superconductivity in a definite range of fields and temperatures. (auth)

26394 MAGNETOSTRICTION OF CERTAIN RCo_5 COMPOUNDS IN STRONG MAGNETIC FIELDS. Khrabrov, V.I.; Shur, Ya. S. (Institute of Metal Physics, Ural Scientific Center, USSR Academy of Sciences). JETP Lett. 20: No. 7, 213-214 (5 Oct 1974).

The magnetostriction of RCo_5 compounds (R=Y, La, Ce, Sm) was measured in pulsed fields up to 200 kOe. It is shown that in the basal plane the striction is due to the magnetostriction of the paraprocess and to the magnetostriction connected with rotation of the magnetization. The saturation of the latter amounts to 40×10^{-6} for YCo_5 and $LaCo_5$, $\sim-300\times10^{-6}$ for $CeCo_5$, and $\sim-500\times10^{-6}$ for $SmCo_5$. (auth)

26395 LOW-TEMPERATURE IRRADIATION AND ANNEALING OF GALLIUM ARSENIDE. Brudnyĭ, V. N.; Krivov, M. A. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 147-149(1974). (In Russian).

In order to obtain detailed information on the process of annealing radiation defects, simultaneous studies were made of the changes of the electric conductivity, concentration of current carriers, and their mobility as a result of electron irradiation at 1.6 to 1.8 MeV and the subsequent annealing of the samples in the temperature interval from 100 to 900°K. The annealing of n-GaAs showed three stages of reduction of the electrophysical properties. Annealing of p-GaAs differed in that it had no low-temperature annealing and reverse annealing of the mobility of the current carriers occurred at temperatures from 300 to 450°K. (JSR)

26396 NEUTRON MEASUREMENT OF THE EFFECT OF A MAGNETIC FIELD ON PHONON LIFETIMES IN NIOBIUM. Pynn, R.; Axe, J. D. (Brookhaven National Lab., Upton, NY). J. Phys., F (London); 4: No. 11, 1898-1907(Nov 1974).

The possibility is considered of observing by inelastic neutron scattering the effect of a large magnetic field on phonon lifetimes in a metal. The effect is discussed for the situation in which the phonon wave vector is perpendicular to the magnetic field. It is concluded that for a general Fermi surface geometry the effect is unobservable with practical spectrometer resolution. However, for metals with large, nearly flat areas of Fermi surface it is found that an effect may be detectable when the phonon wave vector spans the flat areas of Fermi surface and when the latter are parallel to the applied field. An experiment to test this idea in niobium metal suggests the existence of an oscillation in the peak intensity of a [111] LA phonon as a function of applied field. The period of the oscillation gives a cyclotron mass of $(1.3 \pm 0.3)m$ for the jungle gym part of the Fermi surface of Nb. This value is consistent with that obtained by de Haas-van Alphen measurements. (auth)

26397 FLOW STRESS DETERMINATION FOR METALS AT FORGING RATES AND TEMPERATURES. Douglas, J. R.; Altan, T. (Battelle Columbus Labs., OH). J. Eng. Ind.; 97: No. 1, 66-76(Feb 1975).

From winter annual meeting of the American Society of Mechanical Engineers; Detroit, MI (11 Nov 1973).

The uniform compression test is used to determine the flow stress of 403 stainless steel, Waspaloy, Ti-6Al-2Sn-4Zr-2Mo, Inconel 718, Ti-8Mo-8V-2Fe-3Al, and AISI 4340 at various forging temperatures. The ring-compression test is used to determine the flow stress of 6061 aluminum, Ti-7 Al-4 Mo, 403 stainless steel, Waspaloy, 17-7 PH stainless steel, Ti-6Al-4V, Inconel 718, Ti-8Al-1 Mo-V, 7075 aluminum, and Udimet 700 alloy at forging temperatures. All the tests were conducted, at practical deformation rates encountered in forging, on an instrumented high-speed forging press. For the same material and at similar temperature and deformation-rate conditions, the data obtained from the uniform-compression and ring-compression tests were compared. It was found that the results obtained with rings 3-in. O.D., 1.5-in. ID and 1 in. high were practically identical to those obtained from the isothermal uniform-compression tests conducted with samples 1-in. dia and 1.5 in. high. (auth)

26398 THERMAL CONDUCTIVITY OF NIOBIUM IN THE MIXED STATE. Kes, P. H.; van der Veeken, J. P. M.; de Klerk, D. (Univ. of Leiden). J. Low Temp. Phys.; 18: No. 3-4, 355-376(Feb 1975).

The magnetic field dependence of the thermal conductivity of four niobium samples in the mixed state has been investigated at several temperatures and three different field orientations. The samples are of moderate purity, that is, $l_e \approx \xi_0$. At low temperatures, just above H_{c1}, the phonon conductivity can be easily separated. Good agreement is obtained with qualitative predictions of Canel and Vinen for the scattering of phonons by flux lines. At high temperatures both the phonons and the electrons are scattered by the flux lines. Though it is evident that the scattering mechanism is more effective in the case that $H \perp \nabla T$ than for $H \parallel \nabla T$, only a qualitative discussion can be given. Near H_{c2} the finite slopes of the $\lambda(H)$ curves are in qualitative agreement with the gapless superconductivity theory of Caroli and Cyrot, but the dependence on the electron mean free path can be better understood from the theory of pure type-II superconductors of Houghton and Maki. Some aspects of pure type-II superconductivity are also recognized in the anisotropic behavior near H_{c2}. (auth)

26399 INTERPRETATION OF THE YODER-GRIFFIS-CROOKER OBSERVATIONS OF SUSTAINED-LOAD CRACKING IN Ti-6Al-4V. Krafft, J. M. (Naval Research Lab., Washington, DC). J. Eng. Mater. Technol.; 96: No. 4, 275-282(Oct 1974).

From conference on pressure vessels and piping; Miami Beach, FL (24 Jun 1974).

Their recent NRL report documents a substantial degradation in load carrying capability of partially cracked specimens of annealed Ti-6 Al-4V plate in a room air environment. In this paper, the effect is analyzed as a special case of tensile ligament instability model, set up to permit integration of crack growth rate over the path to K_{Ic}. Results show that the time dependence and magnitude of the load carrying capability and of the sustained load crack growth SLC are predictable from plastic flow characteristics, including the transient stress relaxation rate, and from a slight environmental effect. A simplified diagram for engineering assessment of SLC is presented. Importance is attached to the persistence of stress relaxation, as much as to its rate, in inducing SLC. Little effect is expected from the level of fracture toughness to the extent that it is controlled by the process zone size d_T. (auth)

26400 CRACKING OF Ti-6Al-4V ALLOYS UNDER SUSTAINED LOAD IN AMBIENT AIR. Yoder, G. R.; Griffis, C. A.; Crooker, T. W. (Naval Research Lab., Washington, DC). J. Eng. Mater. Technol.; 96: No. 4, 268-274(Oct 1974).

From conference on pressure vessels and piping; Miami Beach, FL (24 Jun 1974).

This study reveals that degradation in load-carrying capacity owing to sustained-load cracking (SLC) can occur in alloys of the Ti-6Al-4V family. Each of eight alloys tested with fatigue-precracked specimens in ambient room air exhibited the phenomenon, with degradations ranging from 11 to 35%. The degree of susceptibility to SLC was seen to be dependent upon crack orientation in rolled plate materials. The threshold stress-intensity factor below which SLC failures will not occur in these alloys, K_{It}, appears to represent a more conservative fracture-safe design parameter than the plane-strain fracture toughness K_{Ic}, which cannot account for time-delayed failures owing to SLC. (auth)

26401 FATIGUE CRACK GROWTH IN SA508-CL2 STEEL IN A HIGH TEMPERATURE, HIGH PURITY WATER ENVIRONMENT. Gerber, T. L.; Heald, J. D.; Kiss, E. (General Electric Co., San Jose, CA). J. Eng. Mater. Technol.; 96: No. 4, 255-260(Oct 1974).

From conference on pressure vessels and piping; Miami Beach, FL (24 Jun 1974).

Fatigue crack growth tests were conduced with 1 in. (25.4 mm) plate specimens of SA508-CL2 steel in room temperature air, 550 F (288 C) air and in a 550 F (288 C), high purity, water environment. Zero-tension load controlled tests were run at cyclic frequencies as low as 0.037 cycles per minute (CPM). Results show that growth rates in the simulated Boiling Water Reactor (BWR) water environment are 4 to 8 times faster than growth rates observed in 550 F (288 C) air and these rates are 8 to 15 times faster than the room temperature rate. In the BWR water environment, lowering the cyclic frequency from 0.37 CPM to 0.037 CPM caused only a slight increase in the fatigue crack growth rate. All growth rates measured in these tests were below the upper bound design curve presented in Section XI of the ASME Code. (auth)

26402 FATIGUE-CRACK PROPAGATION BEHAVIOR OF INCOLOY 800 AT ELEVATED TEMPERATURES. James, L. A. (Westinghouse Hanford Co., Richland, WA). J. Eng. Mater. Technol.; 96: No. 4, 249-254(Oct 1974).

From conference on pressure vessels and piping; Miami Beach, FL (24 Jun 1974).

Linear-elastic fracture mechanics techniques were used to characterize the fatigue-crack propagation behavior of Incoloy 800 in an air environment over the temperature range 75 to 1200 F (24 to 649 C). Crack growth rates were measured over the range 5×10^{-7} to 5×10^{-5} in./cycle. Material Grades 1 and 2 were found to exhibit essentially the same behavior over this range. In general, crack growth rates increased with increasing test temperature, although the increases were less than previously noted for austenitic stainless steels. This difference is probably related to the superior oxidation resistance of Incoloy 800. (auth)

26403 EFFECT OF TEMPERATURE UPON THE FATIGUE-CRACK GROWTH BEHAVIOR OF TWO NICKEL-BASE ALLOYS. James, L. A. (Westinghouse Hanford Co., Richland, WA). Contract AT(45-1)-2170. J. Eng. Mater. Technol.; 95: No. 4, 254-256(Oct 1973).

The techniques of linear-elastic fracture mechanics were used to characterize the fatigue-crack growth behavior of Inconel 600 and Inconel 718 over the temperature ranges 24-649 C and 24-538 C, respectively. In both alloys, an increase in the test temperature produced a significant increase in the fatigue-crack growth rate. Inconel 718 was tested in both the solution-annealed condition and a heat-treated condition. At each of the test temperatures, the heat-treated material exhibited a lower growth rate (a greater resistance to crack extension) at a given value of ΔK (K = stress intensity factor) than did the annealed material. At each of the temperatures, annealed Inconel 600 exhibited a lower crack growth rate than did annealed Inconel 718. However, the crack growth behavior of heat-treated Inconel 718 exhibited superior crack growth resistance (lower growth rates) relative to Inconel 600. (PMA)

26404 COMMENTS ON LOW TEMPERATURE ELECTRICAL RESISTIVITY OF METALS. Srivastava, S. K. (Univ. of Allahabad, India). Acta Phys. Pol.; 47A: No. 1, 3-10(Jan 1975).

An empirical relation has been proposed for describing the electrical resistivity at low temperatures. The phonon electrical resistivity of alkali metals has been computed for various pseudopotentials by incorporating lattice mechanics in the theory. It is found that the Bloch power law is valid up to the temperature below which electron phonon contribution does indeed disappear. At a very low temperature, the phonon drag, rather than the power law, exhibits an exponential behavior and presents appreciable contribution to the resistivity. In that regime, the Bloch-power law fails. The study describes a characteristic temperature of the Martensitic transformation relationship with resistivity, which plays an important role in the description of low temperature resistivity. (auth)

26405 THERMAL CONDUCTIVITY AND ETTINGSHAUSEN COEFFICIENT IN RARE EARTH METALS. Zecchina, L. (Univ. Parma, Italy). Phys. Lett.; 50A: No. 2, 95-96(18 Nov 1974).

Values of thermal conductivity in polycrystalline samples of Y, Gd, Tb, Dy and Yb at 300°K are presented together with their Ettingshausen coefficients. The results are interpreted on the basis of a qualitative multi-band model. (auth)

26406 MOESSBAUER INVESTIGATION OF RADIO FREQUENCY STRICTION VIBRATIONS IN MAGNETIC ALLOYS. Baldokhin, Yu. V.; Makarov, V. A.; Makarov, E. F.; Povitskii, V. A. (Inst. of Chemical Physics, Moscow). Phys. Status Solidi (a); 27: No. 1, 265-271(16 Jan 1975).

Moessbauer spectra of different magnetic alloys (Vicalloy, Permalloy, Invar, etc.) have been studied in an external radio frequency (rf) field. The analysis of the intensity of the sidebands appearing in the spectra at rf pumping is shown to give new information about the spreading and relaxation of ultrasound, the changes of the rf magnetostriction due to the ordering processes, and the anisotropy of the crystal. (auth)

26407 MAGNETIZATION OF $Be_{12}Cr_{1-x}T_x$ ALLOYS NEAR $Be_{12}Cr$. Jesser, R.; Herr, A. (Institut de Physique, Strasbourg). Phys. Status Solidi (a); 27: No. 1, K13-K15(16 Jan 1975).

In the frame of investigations on the electronic structure of the $Be_{12}T$ transition metal beryllides, the results of magnetization measurements on $Be_{12}Cr_{1-x}T_x$ alloys with T = V and Fe and $0 \leqq x \leqq 0.10$ are presented. The $Be_{12}Cr$ compound has been found to be ferromagnetic below 50°K; this behavior has been interpreted based on a collective electron model of ferromagnetism. Linear extrapolation to M = 0 of the M versus x curve in the $Be_{12}Cr_{1-x}V_x$ system indicates that the critical concentration range for appearance of ferromagnetism should lie at about 23 at. % V. This order of magnitude is surprising, considering that residual moment measurements of $Be_{12}Cr_{1-x}V_x$ alloys with x = 0.86 to 0.13 showed the existence of ferromagnetism up to $x \approx 0.80$. Only an enhancement of the superposed paramagnetism may be taken into account for the observed peak in the variation of the electronic specific heat term γ of these alloys with composition. Linear concentration extrapolation to x = 1 in the $Be_{12}Cr_{1-x}Fe_x$ system suggests that Fe substitutes for Cr in $Be_{12}Cr$ with a moment of 0.8 μ_B per atom. This fact is rather surprising, since $FeBe_{12}$ is found to be weakly paramagnetic. It appears that the consequence of the presence of Fe is to increase the moment on the Cr atoms. (auth)

26408 L-III ABSORPTION SPECTRA OF METALLIC Eu, Yb, AND Er. Efremova, N. N.; Nemnonov, S. A.; Finkel'shtein, L. D. (Inst. of Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 38: No. 4, 868-870(Oct 1974). (In Russian).

Absorption spectra were determined for metallic Eu, Yb, and Er and for their oxides. The Eu and Yb oxide spectra were sharply displaced to the short-wave end compared to the metallic forms, i.e., when the valence went from 2 to 3, but with Er the displacement was small, i.e., where not the valence but only the character of the interatomic bond changed. The energy levels are discussed. (auth)

26409 DISTRIBUTION OF ATOMS IN SUBMICROVOLUMES DURING $\alpha \rightarrow \gamma$ TRANSFORMATION OF Fe-52Co-8V. Gruzin, P. L.; Rodionov, Yu. L.; Lu, Yu. A. (Central Scientific-Research Inst. of Metallography and Physics, Moscow). Fiz. Metal. Metalloved.; 38: No. 4, 876-877(Oct 1974). (In Russian).

The NMR spectra of the subject alloy were typical of those for a superfine magnetic resolution. Peaks related to a nonmagnetic gamma phase were absent. The area under the peaks indicates the fraction of iron atoms that contain a definite number of vanadium atoms in the vicinity. Changes in the spectrum that occur upon annealing indicate an $\alpha \rightarrow \gamma$ conversion at 500-700°C. (auth)

26410 DOMAIN STRUCTURE FORMATION IN Ni-Mo ALLOYS. Kirienko, V. I.; Potapov, L. P. (Central Scientific-Research Inst. for Ferrous Metals, Moscow). Fiz. Metal. Metalloved.; 38: No. 4, 817-821(Oct 1974). (In Russian).

An auto-ion microscopy method was used to study domain structure in Ni-Mo alloy systems. The dependence of the orientation relationships of the fields on composition, temperature, and alloy annealing time was established. Basic rules and mechanisms of domain formation were examined. (tr-auth)

26411 FORMATION OF QUASIPERIODIC DISTRIBUTION NUCLEI ON POINTS OF A TETRAGONAL BODY-CENTERED MACRO LATTICE DURING EUTECTOID DECOMPOSITION OF Cu-Be ALLOYS. Tyapkin, Yu. D.; Golikov, V. A. (Central Scientific-Research Inst. for Ferrous Metals, Moscow). Fiz. Metal. Metalloved.; 38: No. 4, 803-811(Oct 1974). (In Russian).

Using a method based on dispersion of x rays and electrons and electron microscopy of thin foils, the late stages of eutectic decomposition of Cu-Be alloys were studied. A new type of quasiperiodic (modulated) structure, characterized by the appearance in the basic reflections of the images of satellites along the ⟨205⟩ directions, was observed. The space distribution of the solid phase which separated at this stage of conversion was studied, and a relation was shown to the subsequent decomposition stage in which particles of the separation phase occur, deformed as a result of coupling in the final ratio of orientation: $[001]_\beta \parallel [1\bar{1}0]_\alpha$, $(250)_\beta \parallel (225)_\alpha$. (tr-auth)

26412 SUBSTRUCTURE CHANGES IN SECONDARY RECRYSTALLIZATION OF FINE TUNGSTEN WIRES. Kantur, O. V.; Kogan, A. N.; Terminasov, Yu. S. (Kuibyshev Polytechnic Inst., USSR). Fiz. Metal. Metalloved.; 38: No. 4, 788-792 (Oct 1974). (In Russian).

Substructural properties of fine tungsten wires, types VA and OChV, during secondary recrystallization in isothermal annealing at 2100-2500°C were studied. Effect of anisotropy of surface energy on reversal of subgrains was considered. Experimental results can be explained by the contribution of the surface energy to the driving force of the recrystallization. (tr-auth)

26413 DIRECTIONAL CRYSTALLIZATION AND MICROSTRUCTURE OF EUTECTIC ALLOY Fe-Fe_2Nb. Azhazha, V. M.; Berdnik, A. P.; Svinarenko, A. P.; Somov, A. I. (Physical-Chemical Inst., Kazan). Fiz. Metal. Metalloved.; 38: No. 4, 766-772(Oct 1974). (In Russian).

Conditions were studied for determining the compositional structure in Fe-Fe_2Nb eutectics of different purities. The micromorphology and crystallography of phase orientation at different values of the crystallization parameters were studied. (tr-auth)

26414 HEAT CONDUCTIVITY AND SPECIFIC ELECTRICAL RESISTANCE OF NICKEL AND NICKEL-NIOBIUM ALLOYS AT 50 TO 800°C. Panakhov, T. M.; Pepinov, R. I.; Muradov, T. I.; Ibragimov, A. I. (Scientific-Research Inst. for Energetics, Azerbaydzhan, USSR). Fiz. Metal. Metalloved.; 38: No. 4, 888-890(Oct 1974). (In Russian).

The thermal conductivity of pure Ni decreased with increase in temperature, reaching a minimum at 360°C and then started to increase with increase in temperature. With increase in the Nb concentration in Ni, both the relative depth of the minima and the slope of the curves decreased. The specific electric conductivity of all the materials studied increased with increasing temperature, with the curves becoming more linear as the Nb concentration increased. (auth)

26415 FIELD-ION MICROSCOPE STUDY OF TUNGSTEN MICROCRYSTALS GROWN FROM GAS PHASE. Potapov, L. P.; Mordyuk, V. S.; Kirienko, V. I.; Martyshchuk, I. I. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Fiz. Metal. Metalloved.; 38: No. 4, 890-893(Oct 1974). (In Russian).

From their external form and microstructure, the crystals could be divided into monocrystals and dendrites, the difference possibly being related to the conditions under which they were grown. The monocrystals were more nearly perfect in structure but inside they had small crystals with disorientations of 2-5°. As a rule, they grew along the [111] direction. The dendrite structures were less nearly ideal and inside were often found strongly disoriented (more than 30°) crystals of 100 to 300 Å. In some dendrites there were micro-cracks, apparently related to the mechanism of their growth. (tr-auth)

26416 LOW-TEMPERATURE HEAT CAPACITY OF $(V_{1-x}Cr_x)Si_{1-y}Ge_y$ ALLOYS WITH A15 STRUCTURE. Surikov, V. I.; Shtol'ts, A. K.; Gel'd, P. V.; Trapeznikov, A. M.; Prekul, A. F. (Ural Polytechnic Inst., Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 38: No. 4, 885-887(Oct 1974). (In Russian).

Results are given of measurements of the temperature dependence (13 to 80°K) of the heat capacity and temperature transitions in the superconducting state for three series of alloys of V, Cr, Si, and Ge. The substitution of V atoms for Cr sharply decreased the density at the Fermi level, but substitution of metalloid atoms in the alloy V_3(Si, Ge) was accompanied by monotonic changes. The changes may be related to changes in filling of the d bands in the case of the $(V, Cr)_3Ge$ and $(V, Cr)_3Si$ alloys when V is substituted for Cr and to widening of the narrow and high peaks formed chiefly by d electrons in V_3Si when Si is substituted for Ge. (auth)

26417 HEAVILY DOPED CRYSTALS OF N-TYPE INDIUM ANTIMONIDE. Filipchenko, A. S.; Nasledov, D. N. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Status Solidi (a); 27: No. 1, 11-26(16 Jan 1975).

The results of investigations on heavily doped n-type InSb crystals have shown that with increasing doping concentration a whole number of qualitatively new phenomena appear which principally manifest the individual properties of different donor impurities. It seems to be established that in InSb crystals a second minimum of the conduction band exists about 0.65 eV above the bottom of the main minimum. When doped with various donor impurities, InSb crystals exhibit an impurity level lying above the bottom of the main minimum of the conduction band (but below the second minimum). The position of these levels is strongly dependent on that kind of dopant. In order to explain the behavior of various effects in heavily doped InSb crystals, an additional scattering mechanism should be introduced whose contribution should depend on that kind of doping impurity. Such a mechanism, most probably, is scattering by short-range potential centers which may originate from ions whose potential, besides the screened Coulomb component, comprises a short-range component due to the mismatch between the ion core potential and the potential of the host crystal. (auth)

26418 CdTe-$Cd_xHg_{1-x}Te$ HETEROSTRUCTURES. Konnikov, S. G.; Ogorodnikov, V. K.; Sydorchuk, P. G. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Status Solidi (a); 27: No. 1, 43-48(16 Jan 1975).

A study is made of the effect of CdTe substrate orientation and of conditions of precipitation on the structure of $Cd_xHg_{1-x}Te$ layers prepared by liquid epitaxy from mercury solutions. Under certain conditions CdTe-$Cd_xHg_{1-x}Te$ heterostructures with a transition region of about 0.5 μm can be obtained. (auth)

26419 INVESTIGATIONS OF THE HALL EFFECT AND CONDUCTIVITY OF $Ga_xIn_{1-x}Sb$. Szlenk, K.; Byszewski, P.; Olempska, Z. (Inst. of Physics, Warsaw). Phys. Status Solidi (a); 27: No. 1, 49-58(16 Jan 1975).

In analysis of the Hall effect and conductivity in mixed compounds $Ga_xIn_{1-x}Sb$, the results of theoretical calculations were compared with the results of experiments in the temperature range 90 to 380°K and in magnetic fields from 0 to 28.3 kG. On the basis of this comparison the scattering processes are discussed and parameters describing them are determined. (auth)

26420 LATTICE RELAXATION AT GLIDE ANTIPHASE BOUNDARIES AND STACKING FAULTS IN Ni_3Mo AND Ni_4Mo. van Tendeloo, G.; Amelinckx, S. (Rijksuniversitair Centrum, Anvers, Belgium). Phys. Status Solidi (a); 27: No. 1, 93-98 (16 Jan 1975).

Relaxation effects at non-conservative growth antiphase boundaries as well as at conservative glide boundaries have been studied by means of electron microscopy in the alloys Ni_3Mo and Ni_4Mo. It is shown that due to the presence of wrong bonds a relaxation of the lattice occurs along the interfaces. This gives rise to a small supplementary displacement ϵ, resulting in a residual contrast effect. The direction and the sense of ϵ have been determined from diffraction experiments. Glide antiphase boundaries produce a stronger residual contrast than growth boundaries; it is shown that this is associated with the presence of Mo-Mo first neighbors along the glide boundaries. (auth)

26421 DISLOCATION SUBSTRUCTURES IN THE ANOMALOUS SLIP PLANT OF SINGLE CRYSTAL Nb STRAINED AT 50 K. Louchet, F.; Kubin, L. P. (CNRS, Toulouse). Acta Met.; 23: No. 1, 17-21(Jan 1975).

Anomalous $(0\bar{1}1)$ slip traces were detected in Niobium after straining at 50 K. TEM analysis was performed on samples cut parallel to $(0\bar{1}1)$. Dislocation substructures, intersections, pinned and serrated dislocations, were analyzed. The intersection of two $\alpha/2$ ⟨111⟩ dislocations was found to produce α ⟨100⟩ screw fragments. The planar structure of some of the observed dislocation configurations seems to result locally from glide in the $(0\bar{1}1)$ plane. (auth)

26422 LOW TEMPERATURE SPECIFIC HEAT OF BERYLLIUM COMPOUNDS OF THE FIRST TRANSITION METAL SERIES BETWEEN VBe_2 AND $FeBe_2$. Kuentzler, R.; Jesser, R. (Univ., Strasbourg). J. Phys., F (London); 4: No. 11, 1916-1923(Nov 1974).

Specific heat measurements were performed on TBe_2 and $(T,T')Be_2$ beryllium compounds, where T and T' are neighbor transition metals of the first series. The temperature range investigated is 1.5 to 4.2°K. For the paramagnetic alloys with $5 < e/a < 7$, there is a regular behavior of the electronic specific heat coefficient γ with a minimum at $e/a = 6.12$ and, the two half d bands with opposite spin directions are equally unfilled in agreement with the paramagnetic behavior of the compounds. In the electronic concentration range $7 < e/a < 7.6$, the large peak of γ at about $e/a = 7.16$ is mainly ascribed to clustering effects due to the appearance of ferromagnetism. Above $e/a = 7.6$, γ decreases down to a minimum at $e/a = 8$ where there is a transition from weak to strong ferromagnetism. A number of similarities between TBe_2 and T are noticed, but there is no uniform effect of Be on the transition metals T. (auth)

26423 FRACTURE TOUGHNESS OF AMORPHOUS METALS. Kimura, H.; Masumoto, T. (Tohoku Univ., Sendai). Scr. Met.; 9: No. 3, 211-221(Mar 1975).

The fracture toughness was measured for amorphous Fe-13P-7C, Pd-20Si, and Cu-43Zr using a trouser leg type tear test. The tearing energies, crack extension forces, and the fracture toughnesses were comparable with those of strong steels. The tearing energy showed an approximate linear relationship to the nominal yield stress, and was also found to be a function of tearing speed and sample temperature. (PMA)

26424 SOLID SOLUTION HARDENING AND SOFTENING IN ⟨110⟩ AND ⟨100⟩ Ta-W SINGLE CRYSTALS. Parikh, P. D. (Olin Metals Research Lab., New Haven); Hay, D. R. Scr. Met.; 9: No. 3, 229-232(Mar 1975).

Results are described for a study of the orientation dependence of the thermal and athermal components of the flow stress of Ta-W single crystals tested in compression. An orientation dependent solid solution softening was observed. Athermal hardening was found to be orientation independent and exhibited an $(\text{at. }\%)^{\frac{1}{2}}$ dependence up to about 7 at. %, above which, the data does not conform to any current theories. (PMA)

26425 ANALYSIS OF SUBGRAIN BOUNDARIES IN Mo SINGLE CRYSTALS. Vesely, D. (Oxford Univ.). Scr. Met.; 9: No. 3, 233-238(Mar 1975).

The nature of dislocation walls (or subgrain boundaries) was studied in strained Mo single crystals. The dislocation walls which are formed at the early stages of deformation, parallel to primary slip planes give a rotation along one well defined direction, regardless on the amount of rotation. High long range stresses are formed where the dislocation walls terminate within the crystal. The rotation and therefore the stress fields initially increase with strain. With further deformation the stresses are relaxed by the formation of short segments between the parallel dislocation walls. The mechanism of dislocation-wall interaction is thus changed to a cutting through the dislocation walls. (PMA)

26426 TWO STAGE YIELDING IN Au–Cd–Cu THERMOELASTIC MARTENSITE. Miura, S. (Doshisha Univ., Kyoto); Ito, M.; Nakanishi, N. Scr. Met.; 9: No. 3, 247-250(Mar 1975).

Stress-strain curves were found for a Au–47.5 at. % Cd–0.25 at. % Cu martensite phase alloy at room temperature. Continuous yielding occurred in two stages in the case of the martensite phase obtained from a multiple-interface transformation. The critical stress for the first plateay was extremely low (about 1.5 Kg/mm^2) while that for the second plateau was high (12–15 Kg/mm^2). When the applied stress was removed, the former left a residual strain but the latter did not. The residual strain was completely recovered on heating above the Af temperature, indicating that the deformation did not occur by slip. The martensite phase obtained by a single-interface transformation sometimes showed stress-strain curves in which the first plateau had disappeared or the extent of first plateau was very small. (PMA)

26427 PLASTIC INSTABILITY IN A METALLIC GLASS. Davis, L. A. (Allied Chemical Corp., Morristown, NJ). Scr. Met.; 9: No. 3, 339-241(Mar 1975).

Strips of Ni–29Fe–14P–6B–2Si, rapidly quenched from the melt, were tested under tensile loading in an MTS machine in stroke control at a stroke rate of ~2.5×10^{-3} mm/sec. Uniform cross section strips fail (at the grips) in the 45° slant mode. Specimens with a relatively wide gage section (~0.7 mm) can also fail by this mode in the gage section. Specimens with a narrow gage section (<0.6 mm) fail coincident with general yielding and the fracture surface makes an angle of ~53° with the tensile axis. For these three cases the observed fracture stresses are ~207 ± 3, 225 ± 8 and 243 ± 7 Kg/mm^2, respectively; the latter value is also the tensile yield strength of the material. (PMA)

26428 DISPLACIVE TRANSFORMATIONS IN Nb–Ru. Das, B. K.; Lieberman, D. S. (Univ. of Illinois, Urbana). Scr. Met.; 9: No. 3, VIII-IX(Mar 1975).

Displacive phase transformations in near-equiatomic Nb–Ru alloys have been studied using electrical resistivity measurements, optical metallography and x-ray diffraction. Alloys containing between 41 and 45 at. % Ru undergo a CsCl (β) to tetragonal (β') transformation on cooling from 1500°C to room temperature. Alloys containing more than 46 at. % Ru exhibit a two step CsCl (β) to tetragonal (β') to orthorhombic (β'') transformation on cooling to room temperature. Although the product of each successive transformation consists of stacks of twins (in $\beta' \rightarrow \beta''$, twins within twins), the transformations do not proceed by the advance of sharp planar interfaces as in many of the first order martensitic transformations resulting in morphologically similar products. Rather, the interphase region consists of a small volume of the crystal over which the parent phase is gradually distorted into the product phase. (auth))

26429 EFFECT OF THERMAL TREATMENT ON MICROSTRUCTURE OF Ti–6Al–4V. (RMI Co., Niles, OH). Metal Progr.; 107: No. 3, 72(Mar 1975).

Micrographs are presented which show structural changes that can be brought about by heating Ti–6Al–4V to a series of elevated temperatures, and cooling at different rates from each temperature. Room temperature tensile properties for each annealing treatment, and properties following aging for 4 hr at 1000°F (540°C), are listed in an accompanying table. (PMA)

26430 NASA VANE ALLOY BOASTS HIGH-TEMPERATURE STRENGTH. Waters, W. J.; Freche, J. C. (Lewis Research Center, Cleveland). Metal Progr.; 107: No. 3, 57-60(Mar 1975).

Alloy WAZ-20 (17–20 W, 6–7 Al, 1.4–1.6 Zr, 0.1–0.2 C, bal Ni) has an incipient melting temperature of 1300°C and has a tensile strength of 138 MPa (20,000 psi) at 1205°C. Other desirable properties include an unusually high impact strength and apparent microstructural stability. Additional work was done to enhance the properties of WAZ-20. Primary goals were to reduce the alloy's average density of 9.02 g/cm^3 (0.326 lb/in.^{3}) to a level below that of most commercially used vane alloys, and simultaneously improve its already attractive high-temperature properties. These goals were met with a new alloy–WAZ-16–having a nominal composition of 16 W, 7 Al, 2 Mo, 2 Cb, 0.5 Zr, 0.2 C, bal Ni. (PMA)

Radiation Effects

Refer also to abstracts 25563, 25583, 25805, 27963, and 28019.

26431 (AD-784321) EFFECT OF ELECTRON IRRADIATION ON MECHANICAL PROPERTIES AND STRUCTURE OF ALUMINUM. Bondarenko, G. G.; Ivanov, L. I. Translated from Fiz. Khim. Obrab. Mater.; No. 6, 47-50(1972). 11p. (FSTC-HT-23-29-74). NTIS $4.00.

Samples of aluminum of varying degrees of purity (99.9 and 99.99%) were irradiated with 2.3 MeV electrons at room temperature. The irradiation rate was 1×10 to the 14th power electron/sq cm × s and the dose range (2.5 to 7.2) × 10 to the 18th power electron/sq cm. Tensile strength testing of the irradiated samples showed a noticeable change in mechanical properties of the aluminum (99.9%). This change is connected with the discovery of accumulations of point defects in these samples, which were effective stops to movement of dislocations. (GRA)

26432 (ANL-Trans-973) STUDY OF ATOMIZATION AND BLISTERING OF CERTAIN MATERIALS BOMBARDED WITH HYDROGEN AND HELIUM IONS. Gusev, V. M.; Guseva, M. I.; Ionova, E. S.; Krasulin, Yu. L.; Mirnov, S. V.; Nedospasov, A. V. Jan 1975. Translation of Issledovanie Raspyleniya I Blisteringa Nekotorykh Materialov Pri Bombardirovke Ionami Vodorda I Geliya. 16p. Dep. NTIS $4.00.

The study was carried out on several materials which are promising for use as thermonuclear reactor first walls. Atomization was carried out on graphite and 0 × 16 N15M31 stainless steel at 10 to 20 keV; blistering, on small –Z metals (Al, Ti, V, Ni, Mo) at 20 to 100 keV. (3 tables, 5 fig) (DLC)

26433 (COO-2317-3) STUDY OF FERRITE FORMATION IN NEUTRON IRRADIATED AUSTENITIC STAINLESS STEELS. Progress Report, March 1, 1974–February 28, 1975. Stanley, J. T.; Hendrickson, L. E. (Arizona State Univ., Tempe (USA)). 1975. Contract AT(11-1)-2317. 26p. Dep. NTIS $4.50.

Magnetization measurements were carried out on a number of neutron irradiated austenitic stainless steel specimens to determine the total ferrite content of these specimens. Two heats of Type 316 and one heat of Type 321 stainless steel were neutron irradiated at temperatures of 425, 530, and 620°C to fluences of 1.8 and 3.5×10^{22} n/cm^2 (E > 0.1 MeV). However, the field of possible combinations of irradiation conditions and specimen composition and thermo-mechanical history was only partly covered by this investigation. The maximum amount of ferrite (5.6%) was found in the Type 321 irradiated at 530°C to 3.5×10^{22} neutrons/cm^2. Minimum amount of ferrite (0.08%) was found in one heat of Type 316 irradiated to 3.5×10^{22} at 620°C. However, under similar irradiation conditions the other heat of Type 316 contained 1.9% ferrite. A third heat of Type 316 was proton irradiated at 500°C with 1 MeV protons. A maximum of about 21% ferrite was observed in this specimen. The magnetization curves for these specimens indicate that the ferrite phase is present as fine particles. The temperature dependence to the magnetization curves follows the Curie law for some specimens but Curie-Weiss law behavior is indicated for most of the specimens. Electron microscopy of the Type 321 specimen confirmed the presence of fine ferrite particles. (auth)

26434 (COO-3158-34) AN IN-SITU FIELD ION MICROSCOPE STUDY OF IRRADIATED TUNGSTEN AND TUNGSTEN ALLOYS. I. The Volume Change of Migration of the Stage I Self-Interstitial Atom. Report No. 2346. Wilson, K. L.; Seidman, D. N. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). Dec 1974. Contract AT(11-1)-3158. 21p. Dep. NTIS $4.25.

A detailed study was performed of the effect of the electric field (~4.75VÅ^{-1}) required for field ionization of helium gas atoms in the field ion microscope (FIM), on the isochronal recovery spectrum of ion (30 keV W$^+$) irradiated tungsten. All the irradiations were performed in-situ under ultra-high vacuum conditions (< 10^{-9} torr) with a constant dose of $5 \cdot 10^{12}$ ion cm^{-2}. The FIM specimens used were prepared from oriented single crystals of high purity tungsten with a resistivity ratio of $5 \cdot 10^4$. The experimental procedure involved a comparison of the isochronal recovery spectra in the range 18 to 120K of specimens irradiated at 18K in the absence of both the electric field and the imaging gas, with identical specimens which were irradiated at 50K and then cooled to 18K in the absence of the electric field. The results of these recovery experiments demonstrated that the field of ~4.75VÅ^{-1} has only a minimal effect on the annealing kinetics of self-interstitial atoms (SIA's) and that the volume change of migration of the Stage I SIA is less than 0.02 atomic volume. This result strengthens our contention that SIA long-range migration occurs at ~38K and that Stage I recovery is certainly completed by ~45K for tungsten. This result is in contradistinction to other investigations which have assigned SIA long-range migration in tungsten to the 70 to 100K range. (auth)

26435 (TID/SNA-124) RADIATION EFFECTS PROGRAM PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 138p. Dep. NTIS $10.00.

Test Plans M-23 and M-40 are irradiation experiments, which are high priority irradiation experiments, specifically aimed at obtaining fundamental data for planning of radiation effects tests.

M-23, Stress and Radiation Synergistic Effects, has the initial objective of determining whether two materials, Inconel 718 and AISI 304, (which are known to be subject to gaseous hydrogen embrittlement at and near room temperature) when irradiated to a high fluence in 610°R reactor water and post-radiation tested at 80°F are subject to an increased hydrogen embrittlement. The M-23 test plan is given high priority because the results conceivably could change the requirements for many future materials radiation tests. The M-40 Test Plan, "LH_2, LN_2, GH_2 and GHe Correlation," compares the radiation effects in the presence of inert atmospheres LN_2 and GHe with LH_2 and GH_2. It is believed the atmosphere differences will be negligible at cryogenic temperatures; however, a verification is desirable in view of the high reliability requirements imposed on NERVA components. (auth)

26436 (TID/SNA-509) CRYOGENIC RADIATION EFFECTS ON AISI 347 STEEL FORGING, s110-XSS13-W181f1. Final Report GTR-20C. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Mar 1971. 55p. Dep. NTIS $5.75.

Tensile button-head specimens fabricated from an AISI 347 forging were irradiated to three fluences (approximately 6×10^{17} n/cm^2, 1×10^{18} n/cm^2 and 5×10^{18} n/cm^2 > 1 MeV) and subsequently tensile tested at 140°R. During irradiation and testing, the specimens were submerged in liquid nitrogen to maintain the cryogenic temperature. Nine specimens irradiated to a fluence of approximately 5×10^{18} n/cm^2 >1 MeV were annealed at 540°R for three time periods, 3 each at 10, 100, and 1000 minutes prior to tensile testing in liquid nitrogen. During the 100 minute annealing period resonant frequency measurements were conducted on three of these specimens to determine Young's modulus changes. The AISI 347 forging tensile property most sensitive to radiation was 0.2% offset yield strength, which exhibited significant increases for each level of fluence (6.2×10^{17}, 1.2×10^{18} and 5.0×10^{18} n/cm^2 > 1 MeV). The 0.2% offset yield strength showed significant decreases for each annealing period (10, 100 and 1000 minutes at 540°R). Approximately equal reductions in 0.2% offset yield strength were obtained for each of the three time periods of annealing. Ultimate strength increased with all levels of fluence and showed a significant (95% confidence) increase at a mean fluence of 5.0×10^{18} n/cm^2 > 1 MeV. Annealing produced no significant changes in ultimate strength. No significant changes due to irradiation and annealing were observed in percent elongation and reduction of area for AISI 347 forging specimens. In all three of the AISI 347 forging tensile specimens irradiated to a mean fluence of 5.0×10^{18} n/cm^2 (>1 MeV) a significant reduction in resonant frequency, Hz, was observed indicating a small decrease (about 2%) in Young's modulus due to irradiation. (auth)

26437 (TID/SNA-754) MULTIPLE REGRESSION ANALYSIS OF CONSOLIDATED RADIATION EFFECTS DATA, NERVA MATERIALS. Tensile Properties of Titanium-5Al-2.5 SN ELI (Parent Metal); s110-TA02-W181-7b. Brown, D. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 50p. Dep. NTIS $5.50.

Radiation effects data for tensile properties of titanium–5Al–2.5Sn (ELI) were collected from various test sources and experiments over a five-year period. These data were consolidated into one matrix for analysis. The variables for the forgings, bar, plate, and sheet included: (1) neutron fluence (>1.0 MeV) levels over the range of 5×10^{16} to 1.1×10^{18} n/cm^2, irradiated at cryogenic temperatures, and unirradiated controls; (2) test temperatures from 30 to 540°R, and (3) strain rates of 0.0015 to 0.0666 in./in./min. Multiple regression models were fitted to the data for yield strength and ultimate strength, resulting in prediction equations. The specific prediction equations associated with the models adequately represent the responses for yield strength and ultimate strength. Yield strength was not a function of the material form. Strain rate was not a significant factor for either yield strength or ultimate strength. Appropriate models for the responses of elongation and reduction of area could not be determined. However, a significant effect of radiation on elongation was confirmed, while reduction of area was not affected by radiation. The prediction equations were solved for various environmental conditions, and results shown in tabular and graphic form. (auth)

26438 (TID/SNW-12) EFFECT OF NUCLEAR RADIATION ON METAL BEHAVIOR AT CRYOGENIC TEMPERATURE. Coombe, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1968. 13p. Dep. NTIS $4.00.

Results of radiation effects testing of metals at cryogenic temperatures are presented. Materials included are Ti-base alloys, Ni-base alloys, Al-base alloys, Inconel, and stainless steel. (JRD)

26439 (WANL-TME-1822(Rev.1)) FINAL TEST SPECIFICATION: INCONEL-718 MATERIALS TEST, 37/W410; STEM SPECIMENS, 15/W202; STRESS RELAXATION SPECIMENS, 15/W101. Revision One. Burwell, D. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1968. 33p. Dep. NTIS $4.75.

Specifications are given for irradiation testing of Inconel-718 at temperatures from 140 to 2000 R at a thermal neutron fluence of 1×10^{19} nvt and a fast neutron fluence of 1×10^{19} nvt. The testing of silicone cement used in cemented end caps of the specimens is also specified. (SFL)

26440 (WANL-TME-1960) TEST SPECIFICATION: BERYLLIUM THERMAL CONDUCTIVITY IRRADIATION TEST 37/W414. Coombe, J. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1969. 8p. Dep. NTIS $4.00.

Specifications are given for irradiation testing of Be specimens at 80°K and neutron fluences of 5×10^{17}, 2×10^{18} and 5×10^{18} nvt (E > 1 MeV). Thermal conductivity and electrical resistivity measurements during irradiation are specified. (SFL)

26441 METHOD TO CALCULATE THE MOMENTS OF THE DISTRIBUTION FUNCTION OF A PRIMARY ATOM PRODUCED BY IRRADIATION. Corciovei, A.; Dumitru, D. R. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 6, 593-604(1974).

A method is presented to calculate the averages over the products of different orders of the components of the end position vector of the primary atom produced by the incident radiation. The proposed method relies on the use of an integral equation of the distribution function of the components of the end position vector. The integral equation for the Fourier transform of the distribution function is written. This last integral equation allows to calculate step by step all the coefficients of a suitable expansion of the Fourier transform. The averages are easily expressed in terms of these coefficients. (auth)

26442 DAMAGE IN NEUTRON-IRRADIATED MOLYBDENUM. I. Characterization of As-Irradiated Microstructure. Sikka, V. K.; Moteff, J. (Cincinnati Univ., Ohio (USA). Dept. of Materials Science and Metallurgical Engineering). J. Nucl. Mater.; 54: No. 2, 325-345(Dec 1974).

The as-irradiated microstructure of molybdenum, irradiated in the EBR-II reactor at six different temperatures in the range 430–1000°C (0.24–0.44 T_m) to a fast neutron fluence of $\sim 1 \times 10^{22}$ n.cm^{-2} (E > 1 MeV), was characterized as black spot clusters, loops, rafts, voids (random and ordered) and dislocations. Present results show that both the void density, N_v and the void size, d_v, are independent of irradiation temperature in the range 430–700°C. Above the 700°C irradiation temperature the void density decreases and the void size increases exponentially with increasing irradiation temperature and they have been expressed empirically as $N_v = 3.6 \times 10^{20} \exp(-26.9\ T/T_m)$, $d_v = 1.5 \exp(9.44\ T/T_m)$, where T/T_m is the irradiation temperature presented as a fraction of the melting point. The void density of all available published data was used to show that the void density is a strong function of irradiation temperature for a constant number of displacements per atom (dpa), and a function of reactor power and spectrum when normalized to dpa. (auth)

26443 HIGH-VOLTAGE ELECTRON IRRADIATION STUDIES OF SEVERAL OVERAGED γ/γ' ALLOYS. Ardell, A. J. (California Univ., Los Angeles (USA). School of Engineering and Applied Science); Mastel, B.; Laidler, J. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). J. Nucl. Mater.; 54: No. 2, 313-324(Dec 1974).

The formation of irradiation-induced dislocation loops was studied in four Ni-base γ/γ' alloys, severely overaged so that the influence of individual γ/γ' interfaces could be investigated. The alloys, Ni–14.07% Al, Ni–12.68% Si, Ni–18% Cr–7% Al and Nimonic PE-16 were irradiated, using 1 MeV electrons, for various times at an irradiation temperature of 425°C to produce dislocation loops. Void formation was also induced in overaged PE-16 at an irradiation temperature of 490°C. In the binary alloys the distribution of dislocation loops was fairly uniform throughout the γ and γ' phases, the semicoherent interfaces having no apparent influence on loop formation. The Ni–Si alloy was more radiation damage resistant than the Ni–Al alloy. In the ternary alloy the nucleation and growth of dislocation loops were evidently somewhat easier in the matrix than in the γ' phase, but the coherent γ/γ' interfaces did not influence the spatial distribution of loops. The situation in PE-16 was vastly different; both dislocation loops and voids nucleated and grew preferentially in or near the coherent γ/γ' interfaces. A model is proposed which qualitatively accounts for these observations by invoking the large difference in the chemical constituents of the γ and γ' phases in PE-16 and the manner in which this factor affects the production of Frenkel pairs and the nucleation of dislocation loops and voids. Some consequences of this model are briefly discussed. (auth)

26444 ANNEALING STUDY OF GOLD, ZINC AND GERMANIUM ALLOYED ALUMINIUM NEUTRON-IRRADIATED AT LIQUID NITROGEN TEMPERATURE. Kontoleon, N.; Papathanassopoulos, K.; Chountas, K.; Andronikos, P. (Democritus Nuclear Research Center, Athens (Greece)). J. Nucl. Mater.; 54: No. 2, 265-274(Dec 1974).

A study of the recovery of the electrical resistivity of dilute aluminum alloys Al–Au (0.02–0.25 at % Au), Al–Zn (0.05–1.0 at % Zn) and Al–Ge (0.02–0.5 at % Ge) after neutron-irradiation at a total dose of 9×10^{18} n/cm^2 at 78 K was undertaken. The annealing spectra of Al–Au and Al–Zn alloys showed two distinct substages in stage II, while in Al–Ge alloys a five-peak structure was apparent. At the low-temperature side of the main peak of stage III a shoulder is definitely apparent in the three alloy systems. After stage III, Al–Ge alloys appear to have two doublets and a reverse recovery resistivity, which can be attributed to the formation of Guinier-Preston zones. The break-up of interstitials from impurity atoms or their clusters and the trapping of vacancy-type defects during their migration in stage III are the mechanisms which can explain stages II and III respectively. The activation energy for the main peak of stage III was in all cases found to be 0.60 eV, and the peak obeys second-order kinetics. (auth)

26445 RADIATION AND ANNEAL HARDENING IN NEUTRON-IRRADIATED VANADIUM. Shiraishi, K.; Fukaya, K.; Katano, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). J. Nucl. Mater.; 54: No. 2, 275-285 (Dec 1974).

Vanadium samples were neutron irradiated at the reactor ambient temperature to fluences in the range from 2.0×10^{17} to 1.0×10^{20} n/cm^2 ($E_n \geq 1$ MeV). The radiation hardening measured at the ambient temperature increased linearly with the square root of the neutron fluence, up to a fluence of about 2.5×10^{19} n/cm^2, to approximately 25 kg/mm^2 for the highest fluence. The radiation-anneal hardening phenomenon was clearly observed in samples irradiated at a low fluence (2.0×10^{17} and 1.0×10^{18} n/cm^2) and the hardening was accompanied by changes in the density and size distributions of the radiation-produced defect clusters. The radiation hardening induced during irradiation to 1.0×10^{20} n/cm^2 recovered monotonically as the annealing temperature increased. Defect clusters invisible in the electron microscope played an important role in the radiation and anneal hardening except when radiation hardening was induced at the highest fluence (auth)

26446 THE TEMPERATURE DEPENDENCE OF NICKEL-ION DAMAGE IN NICKEL. Sprague, J. A.; Westmoreland, J. E.; Smidt, F. A. Jr.; Malmberg, P. R. (Naval Research Lab., Washington, D. C. (USA)). J. Nucl. Mater.; 54: No. 2, 286-298(Dec 1974).

The temperature dependence of void and dislocation structures was studied in high-purity nickel irradiated with 2.8 MeV $^{58}Ni^+$ ions to a displacement density of 13 displacements per atom (dpa) at a displacement rate of 7×10^{-3} dpa/sec over the temperature range 325 to 625°C. Dislocation loops, with no significant concentrations of voids, were observed in specimens irradiated at 475°C and below. Specimens irradiated between 525 and 725°C contained both voids and dislocations. The maximum swelling was measured as 1.2% at 625°C. Analysis of the data by theoretical models for void nucleation and growth indicated that the swelling in the present experiment was principally limited by void growth at low temperatures and by void nucleation at high temperatures. The data were also compared with previously reported neutron and nickel-ion irradiation results. (auth)

26447 CALCULATION OF THE DAMAGE DISTRIBUTION PRODUCED BY AN ISOTROPIC FISSION FRAGMENTS SOURCE: APPLICATION TO THE STAINLESS STEEL SHEATH OF UO_2 FUEL. Leteurtre, J.; Pouchou, J. L.; Soullard, J.; Zuppiroli, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section d'Etude des Solides Irradies). J. Nucl. Mater.; 54: No. 2, 254-258(Dec 1974). (In French).

The damage distribution produced by an isotropic fission-fragment source in contact with a metallic target was investigated. More precisely, the density of energy transferred by such a source to the target lattice was computed as a function of the depth in the target. The basis of these calculations is Lindhard's theory which gives for each fission fragment emitted by the source the energy lost in atomic collisions. The results can be applied to the fission-fragment damage produced by the fuel of a nuclear reactor in the cladding which contains it. (auth)

26448 RADIATION DAMAGE IN METALS AND SEMICONDUCTORS. Frank, W. (IBM Watson Research Center, Yorktown Heights, NY). pp 3-16 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semiconductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226–.

A survey of present knowledge about radiation damage in crystalline solids is presented. The subject matter is specially selected to facilitate comparisons between metals and semiconductors. The damage pattern produced by different kinds of irradiation and the experimental techniques available for the investigation of radiated-induced defects are described. It is emphasized that the key problems in the understanding of radiation damage in the most thoroughly investigated materials (i.e., fcc metals and elemental semiconductors) center around the nature of the self-interstitials. Theoretical reasons for the complex behavior of these defects are discussed. An interpretation for radiation damage annealing in silicon is suggested. (auth)

26449 POSSIBLE RADIATION ENHANCED DIFFUSION OF NICKEL IONS IN TITANIUM. Turner, J. F.; Temple, W.; Dearnaley, G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 437-442 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semiconductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226–.

An initial study of high flux rate implantations of nickel ions into polycrystalline titanium was made using the Harwell Ion Separator, with doses of 40 keV ions up to a few $\times 10^{18}$ ions/cm^2, at flux rates up to 4.4×10^{14} ions/cm^2 sec (~70 μA/cm^2). Penetration depths approaching 1 μm have been observed (to be compared with a Lindhard stopping depth of $\sim 2 \times 10^{-2}$ μm), with a very high retention of Ni ions (up to ~90% of the dose). The profiles of implanted nickel appear not to be compatible with observed thermal diffusion coefficients, but could be compatible with a radiation enhancement. (auth)

26450 INFLUENCE OF ION BOMBARDMENT ON THE CORROSION OF METALS. Ashworth, V. (Univ. of Manchester, Eng.); Carter, G.; Grant, W. A.; Jones, P. D.; Proctor, R. P. M.; Sayegh, N. N.; Street, A. D. pp 443-453 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semi-conductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226–.

Results are presented of a preliminary investigation of the possibility of altering the surface corrosion of metals by ion implantation. Polycrystalline samples of Cu, Al and Fe were implanted with high fluences (>10^{16} ions.cm^{-2}) of 40 KeV ions of Ar^+, Al^+, B^+, Fe^+, or Mo^+. The samples were examined visually, after irradiation treatment and following long periods of atmospheric exposure or accelerated salt-spray cabinet immersions. These observations showed that, (for copper) at the lower fluences of Ar^+ and B^+ used, similar tarnishing occurred as with the unbombarded samples whereas at the higher fluences, surfaces retained their high degree of polish. Salt-spray tests with Fe samples also showed a reduced tendency for rusting following high fluence Ar^+ implants. Potentiostatic measurements of passivation and corrosion currents for implanted samples immersed in suitable electrolytes were also measured. High fluence implantations into Cu produced some variation in the polarization curves, while for the Al samples a large increase in the passive region of the V/I characteristic was obtained. Since similar effects were observed with most of the implant species employed, it is suggested that the measured effects are due to changes in para-surface defect structures. (auth)

26451 IMPLANTATION AND DIFFUSION OF Cu IN Be. Meyers, S. M.; Beezhold, W.; Picraux, S. T. (Sandia Labs., Albuquerque, NM). pp 455-464 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semi-conductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226–.

The implantation and diffusion of Cu in single-crystal Be was studied. Backscattering of 2 MeV He^+ ions was used to determine the concentration-versus-depth profile to ≈2 μm with a resolution of ≈ 300 Å. Room temperature implantations were made 8° from the C and A crystalline axes respectively, at 100 keV incident energy. Implantation fluences of $4\text{-}5 \times 10^{16}$ Cu/cm^2 were used throughout, except for one lower fluence ≈ 7×10^{15}/cm^2. The position (900 ± 100) Å and width (850 ± 100) Å of the peak in the Cu profile agree fairly well with the LSS theory. An extended tail at greater depths also was present, however, suggesting enhanced diffusion during the room temperature implantation. Isochronal anneals between 400 and 650°C showed a strongly

temperature-dependent diffusion rate above approximately 550°C, with a much weaker temperature dependence below 550°C. The existence of such a low temperature region is again suggestive of damage-enhanced diffusion. A series of isothermal anneals at 595°C demonstrated that the penetration depth is proportional to the square root of the total anneal time, as expected from the diffusion equation, and showed no evidence of Cu being trapped near the surface. The diffusion constants D_C and D_A for the C and A axes, respectively, are different, with $D_C/D_A = 0.6 \pm 0.1$ at 595°C. Published data for autodiffusion in Be give $D_C/D_A = 0.4$ at 595°C, whereas from the model of LeClaire this ratio is expected to be larger for autodiffusion than for Group IB metals in Be. An even larger inconsistency has previously been reported for diffusion of Ag in Be for which $D_C/D_A = 2.3$ at 595°C. (auth)

26452 ION IMPLANTATION AND RADIATION DAMAGE IN VANADIUM. Linker, G.; Gettings, M.; Meyer, O. (Univ., Karlsruhe, Ger.). pp 465-476 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semi-conductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226-.

Single crystal vanadium was implanted with Ga, Bi, In, Cs, Se and Kr ions in the energy range between 40 and 300 keV and doses in the range 10^{14}-10^{17} ions/cm^2. Implanted samples were analyzed with the backscattering and channeling technique. Damage produced was found to be considerably lower than in elemental semiconductors and only a relatively small dependence on energy and dose was detected. The depth of damage, which was considerably greater than the projected range of the implanted ions was found to be dependent only on the total amount of defects. A strong substitutional component dependence on the atomic radii of the implanted ion was observed for doses up to 10^{16} ions/cm^2. Enhanced room temperature solubilities of Ga in vanadium were achieved with the implantation technique. Good single crystal material was observed in the range of the implanted ions. For higher doses and for Ga implants on heat treatment a formation of a polycrystalline layer in the surface region occurred. A break up of this layer for temperatures higher than 1000°C was accompanied by a total loss of implanted constituent. A broad annealing stage independent of the ion species was observed for the radiation damage between 550° and 900°C. (auth)

26453 LATERAL STRESS MEASUREMENTS IN ION-IMPLANTED METALS AND INSULATORS. EerNisse, E. P. (Sandia Labs., Albuquerque, NM). pp 531-540 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semi-conductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226-.

The cantilever beam technique was used for a brief survey of lateral stress in ion-implanted insulators and metals. The lateral stress results for fused silica bombarded with H and He ions compare favorably with other workers' data obtained with photoelastic measurements. The lateral stress versus fluence curves for H, He, and O ion implants into Ag-phosphate dosimetry glass show structure which can be identified as arising from the superposition of lateral stress introduced by electronic energy deposition and lateral stress introduced by atomic collision energy deposition. These results are the first that use one physical property in the same material to measure the effects of both the energy into electronic processes and the energy into atomic collision processes. The lateral stress was also measured for room temperature implants into Cu, Au, and Er with both the cantilever beam technique and a new "double resonator" technique. In soft metals such as Cu and Au, lattice damage from particle irradiation anneals at room temperature and little lateral stress is observed. Er appears to retain some lattice damage for room temperature He implants and stress buildup is observed. (auth)

26454 SURFACE RECOMBINATION VELOCITY IN p-TYPE InSb UPON ETCHING AND ALPHA-PARTICLE BOMBARDMENT. Euthymiou, P.C.; Skountzos, P.A.; Polychronakis, K.S. (Physics Department, University of Athens, Athens, Greece). J. Appl. Phys. 46: No. 3, 1421-1423 (Mar 1975).

The influence of 3.5-MeV α-particle bombardment on p-type InSb surfaces that have been etched for various lengths of time was investigated. To this effect the surface recombination velocity (S) was studied by photomagnetoelectric (PME) measurements at 64 °K. The value of S determined for a mechanically polished but unetched specimen diminishes as the etching time increases. The surface recombination velocity after an etching time of T (S_T) increases upon bombardment with α-particles to the value S_{st} and the ratio $(S_{st}-S_T)/S_T$ decreases with increasing T. We have explained this change using a model based on different damage distributions of α-particles in "disordered" and crystalline regions due to channeling. (auth)

26455 ELECTRON-IRRADIATION-INDUCED DAMAGE RECOVERY EFFECTS IN LIGHTLY DOPED p- AND n-TYPE α-TIN. Myhra, S.; Gardiner, R.B. (Department of Physics, University of Queensland, St. Lucia, 4067, Australia). J. Appl. Phys. 46: No. 3, 1043-1048 (Mar 1975).

The recovery of the electrical resistivity and thermoelectric power in a number of n- and p-type α-tin samples, irradiated at low temperature, is considered. Three distinct first-order stages in the temperature range 20-50 K are observed. A fractional defect recovery has been deduced such that relative percentages of $I_A : I_B : I_C = 90 : 4 : 6$ anneal in the three stages. Activation energy scaling factors were found to be 69, 94, and 122 meV, respectively, for the three stages. Carrier mobilities as functions of carrier and defect concentration were calculated and found to be in good agreement with previously published values. Estimates for these quantities were also deduced when the samples were near to their intrinsic states ($n_e \sim n_h$). A close-pair-defect charge carrier trapping model provides a consistent explanation for all damage and recovery data. (auth)

26456 DAMAGE RATES IN ELECTRON-IRRADIATED GOLD. Dworschak, F.; Schepp, H.; Wollenberger, H. (Van de Graaff Labor Auchen, der KFA Jülich and Institut für Allgemeine Metallkunde und Metallphysik der TH Aachen, 51 Aachen, Kopernikusstrasse 14, West Germany). J. Appl. Phys. 46: No. 3, 1049-1055 (Mar 1975).

The interaction of gold interstitials with other point defects has been investigated by damage rate measurements in gold at irradiation temperatures between 5.2 and 220 K. At all irradiation temperatures the damage rate intially shows a strong nonlinear decrease with radiation-induced defect density which approximates a linear decrease at higher defect densities. At all irradiation temperatures the initial damage rate is reduced by quenched-in vacancies. Although these observations are consistent with several generally discussed interstitial production mechanisms, the results of irradiation doping experiments represent a serious contradiction against all models, which have been discussed before. A hypothesis, which overcomes this difficulty, is presented. (auth)

26457 CHANGES IN THE CARRIER DENSITY IN SILICON DUE TO IRRADIATION WITH FAST ELECTRONS. Kozlov, I.P.; Logvinenko, T.A.; Lugakov, P.F.; Tkachev, V.D. (V. I. Lenin Belorussian State University, Minsk). Sov. Phys.-Semicond. 8: No. 8, 933-935 (Feb 1975).

An analytic description is given of the dependence of the carrier density in n-type and p-type silicon on the dose of 2.5, 10, 30, and 100 MeV electrons at 50°C. The initial rate of carrier removal is studied as a function of the initial degree of imperfection of silicon crystals (this degree is governed by the growth method as well as by the concentrations of the principal and residual impurities). The initial rates of introduction are obtained for the principal radiation defects: $E_c-0.17$ eV (A centers), $E_c-0.22$ eV (divacancy-oxygen centers), $E_c-0.40$ eV (E centers, divacancies), in n-type crystals, and $E_v+0.18$ eV and $E_v+0.35$ eV (divacancy-oxygen centers), eV+0.21 eV and $E_v+0.27$ eV (divacancies) in p-type crystals. (auth)

26458 INVESTIGATION OF THE ENERGY SPECTRUM OF DEEP LEVELS AND OF THE CARRIER SCATTERING MECHANISM IN EPITAXIAL FILMS OF n-TYPE GaAs IRRADIATED WITH FAST ELECTRONS. Gorain, R.A.; Kachurin, G.A.; Kravchenko, A.F.; Prints, V.Ya.; Skok, E.M. (Institute of Semiconductor Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.-Semicond. 8: No. 8, 978-981 (Feb 1975).

An investigation was made of the temperature dependences (77-300°K) of the mobility and density of free carriers in epitaxial films of n-type GaAs compensated by the bombardment with 3.5-MeV electrons. Energy levels at $E_c-0.155\pm0.004$ eV and $E_c-0.30\pm0.01$ eV were found in films with $n=10^{15}$ cm^{-3}. An additional level at $E_c-0.13\pm0.01$ eV was observed in the carrier density range $n>10^{16}$ cm^{-3}. A model for a qualitative explanation of the anomalously strong temperature dependence of the electron mobility was suggested. It was found that the compensation by fast-electron bombardment revealed the energy spectrum of impurity presence of inhomogeneities. (auth)

26459 FATIGUE CRACK GROWTH RESISTANCE OF SEVERAL NEUTRON IRRADIATED PRESSURE VESSEL STEELS AND WELDS. Shahinian, P.; Watson, H. E.; Hawthorne, J. R. (Naval Research Lab., Washington, DC). J. Eng. Mater. Technol.; 96: No. 4, 242-248(Oct 1974).

From conference on pressure vessels and piping; Miami Beach, FL (24 Jun 1974).

Pre- and postirradiation fatigue crack growth rates in A302-B, A533-B, and A543 steel plate and in two A543 welds (submerged arc and electroslag) were determined at 550 F (288 C) in air. The fracture mechanics approach was used to analyze the experi-

mental data. Neutron irradiation at 585 F (307 C) to 2.5×10^{19} n/cm^2, > 1 MeV, produced no significant effect on resistance to crack growth in A302-B steel and caused only a slight decrease in crack growth resistance of A533-B and A543 steels. Also, the resistance to crack growth of the submerged arc weld was unaffected by the irradiation, but that of the electroslag weld was substantially improved. The crack growth rate versus stress intensity factor range curve for the A302-B steel represents an upper bound for the pre and postirradiation data for the steels and welds of this study. (auth)

26460 DYNAMIC RUPTURE OF GUINIER–PRESTON ZONES DURING IRRADIATION. Grinchuk, P. P.; Kirsanov, V. V. Fiz. Metal. Metalloved.; 38: No. 4, 756-765(Oct 1974). (In Russian).

Effect of different integral doses of fast neutrons on the behavior of the Guinier–Preston zone in the alloy Ni–2 wt.% Be was studied. Neutron irradiation destroyed this zone to complete disappearance. The cause of the destruction is considered to be due to the passage of dynamic crowdions. This theory was developed with computer modeling. (tr-auth)

26461 DESORPTION OF ADSORBED AND CONDENSED GASES ON METALS BY DEUTERONS. McCracken, G. M. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Vacuum; 24: No. 10, 463-467(Oct 1974).

Metal surfaces were bombarded with deuterons at 5 to 35 keV and mass spectra of the gases desorbed observed. The principal gases released are hydrogen and carbon monoxide. Layers of carbon dioxide and water vapor were then bombarded and shown to dissociate. Two methods of measuring the yield of gas released from these layers are described and the results compared. (auth)

26462 MODEL FOR SWELLING RESISTANCE IN α-U IMPARTED BY AN ARRAY OF PRECIPITATES. Hudson, B. (Atomic Energy Authority Research Group, Harwell, Eng.); Codd, I.; Burras, G. A. Acta Met.; 23: No. 1, 101-106(Jan 1975).

Recent observations suggest that an important mechanism in controlling cavitational swelling in uranium undergoing neutron irradiation at temperatures around 670 K is the prevention of a process similar to recrystallization. The array of particles present in adjusted uranium is shown to possess pinning properties which can prevent this recrystallization. The coarsening of the particle array eventually leads to unpinning and the onset of swelling. Many features of the swelling resistance of fuel elements are explained by this model and some suggestions made for further increasing the swelling resistance. (auth)

26463 HOW STRUCTURAL ALLOYS PERFORM IN EBR-II. Greenberg, S. (comp.). (Argonne National Lab., IL). Metal Progr.; 107: No. 3, 89-92; 94(Mar 1975).

Fifteen structural alloys and shield graphite, canned in type 304 stainless steel, were irradiated for 671 days at an estimated average fluence of 3×10^{22} n/cm^2 with energy levels exceeding 0.82 MeV. The materials ranged from aluminum bronze to tool steel. Service temperature was 370°C. Post-radiation examinations included weight change, metallography, hardness change, strength and ductility, impact strength, bend test of welded type 304, spring measurement, and tube-burst tests. Only beryllium copper and tantalum experienced appreciable weight loss and appeared to be unsuitable for use in contact with sodium under conditions of the test. Types 304 and 347 stainless steel and the graphite assemblies experienced no significant changes in mechanical or physical properties. (PMA)

Other Materials

Refer also to abstracts 25805, 25925, 25986, 26239, 26279, 26280, 26282–26294, 26333, 26334, 26441, 26448, 26453, 26463, 26478, 28092, 28241, 28487, 28654, and 28746.

26484 (AD-783851) NONDESTRUCTIVE EVALUATIONS OF COMPOSITE HEATSHIELD MATERIALS BEFORE AND AFTER AN UNDERGROUND NUCLEAR EXPOSURE. Final Report, May 1972–November 1973. Brown, J. R. Jr.; Sanders, H. G.; Pears, C. D. (Southern Research Inst., Birmingham, Ala. (USA)). Jun 1974. Contract F29601-72-C-0058. 122p. (AFWL-TR-73-247). NTIS $4.50.

Nondestructive evaluations were performed on various composite heatshield materials before and after underground nuclear exposure. Quality control nondestructive evaluations were used to select representative rings from a larger sample. Additional nondestructive testing and nondestructive mechanical (NDM) evaluations were used to characterize the selected rings before and after exposure. Improved methods of characterizing rings after exposure were developed and will be implemented in carbon-carbon design programs. The materials evaluated included an angled, tape-wrapped carbon-phenolic (R6300); 3D carbon/quartz-phenolic 3DC/QP); 3D carbon-phenolic (3DCP); 3D carbon–carbon (3 DCC); and felt carbon–carbon (felt CC). All materials were evaluated before underground exposure. After exposure the R6300, 3DCC, and felt CC were evaluated. (auth)

26465 (AD-785429) TRANSPORT OPTICAL AND MAGNETIC PROPERTIES OF SOLIDS. Final Report. Wild, R. L.; Simanek, E. (California Univ., Riverside (USA). Dept. of Physics). Aug 1974. 15p. (AFOSR-TR-74-1378) NTIS $3.00.

The experimental work covered two general areas, one of a study of the thermal treatment on the optical and electrical response of the perovskite oxides. $SrTiO_3$, in particular, was found to be a most interesting and complicated system, where the initial characterization of the material is of utmost importance. Much of the basic work on $SrTiO_3$ may not be valid because of inadequate knowledge of the thermal history. The other experimental area concerns the low-temperature exchange reaction and the effect on the specific heat of magnetic glass systems and rare earth chalcogenides. The theoretical studies were on critical fluctuations near phase transitions and on electron-phonon interactions in metals and magnetic interactions in solids. (GRA)

26466 (AD-785856) ANNEALING STUDIES OF Al^+ IMPLANTED SiO_2 THIN FILMS. Wang, S.; Russell, T.; Royce, B. S. H. (Princeton Univ., N. J. (USA)). 30 Aug 1974. Contract N00014-67-A-0151-0034. 26p. (PSSL-300874). NTIS $3.75.

The trapping of charge in the amorphous SiO_2 layer of metal-oxide-semiconducting devices under ionizing radiation conditions can be modified by implanting the oxide with Al^+ ions. Optical absorption, ESR and MOS capacitance methods were used to study implantation-induced defects in the oxide, the associated change in oxide charge storage, and the stability of the defects to post implantation thermal annealing. A simple model of negative charge storage in the implantation zone combined with positive charge storage in the interface regions was examined. Results of this modeling are discussed. (auth)

26467 (AD-786808) COMPUTER CODE USED IN MONTE CARLO CALCULATIONS OF THE ENERGY DISSIPATION IN A THIN POLYMER FILM BY ELECTRON BEAM SCATTERING. Hawryluk, A. M.; Hawryluk, R. J. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 13 Sep 1974. Contract F19628-73-C-0002. 37p. (TN-1974-51; ESD-TR-74-283). NTIS $3.75.

The computer program used in the Monte Carlo calculations of energy dissipation in a thin polymer film by electron beam scattering is described. The results of those calculations were presented elsewhere. The purpose of the present work is to provide a short user's manual and a listing of the computer program. (GRA)

26468 (AD-786914) NATURE OF SECONDARY RADIATION DEFECTS IN SILICON OF THE P-TYPE. Vavilov, V. S.; Mukashev, B. N.; Spitsyn, A. V. Translated from Vysokomol. Soedin., Ser. B; No. 8, 38-41(Aug 1972). 8p. (FTD-HC-23-2305-74). NTIS $3.25.

Samples of p-type silicon alloyed with boron, aluminum, or gallium, were irradiated at 78K with electrons having an energy of 1.5 MeV, and then subjected to isochronous annealing in the temperature range of 78 to 700K. Information on annealing and radiation defects was obtained from an analysis of carrier concentration data, which was determined by Hall effect and electric conductivity measurements. (GRA)

26469 (AD-787582) RADIATION EFFECTS AND MATERIAL STUDIES IN PbSnTe. Annual Report, 1 August 1974–1 September 1974. Harper, H. T.; Colwell, J. F.; Green, B. (Intelcom Rad Tech, San Diego, Calif. (USA)). 25 Sep 1974. 129p. (RT-8040-002). NTIS $5.75.

The electrical and optical properties of $Pb_{1-x}Sn_xTe$ were measured before, during, and after various electron, gamma, and neutron irradiations, and during subsequent isochronal annealing. These sample types fell into two categories–those with initial carrier densities (>10^{17}/cc) at 80°K (the solid-state recrystallized and epitaxial thin-film samples), and one with a low carrier density (<10^{17}/cc) at 80°K (a vapor-grown sample). A measurement of the energy band gap from optical transmission studies on the high carrier density thin-film samples after an electron irradiation at 9°K revealed an increase in the band gap energy. Modeling of the changes in the electrical and optical properties explains the changes on the basis of defects introduced by the irradiation and of the general structure of the alloy. Correlating the radiation damage as a function of irradiating particles was pursued in an effort to provide a means of predicting the relative damage to be expected in various environments. (GRA)

26470 (NAA-SR-9705) TECHNIQUES FOR MASSIVE HYDRIDING. Taketani, H. (Atomics International Div., Canoga

Park, Calif. (USA)). 20 Apr 1965. Contract AT(11-1)-Gen-8. 24p. Dep. NTIS $4.25.

Declassified 10 Mar 1975.

A precipitation hydriding process was developed for massive hydriding of Zr–10 wt % U alloy to a high hydrogen content (1.5 to 2.0 wt % H) without cracking. This process consists of precipitating pro-eutectoid δ-hydride nuclei, by cooling, and utilizing these nuclei as grain refiners. This results in fine equiaxed hydride grain structure, whereas conventional hydriding methods result in columnar grains. By using this method, the yields of sound massive hydrides have been increased from 50 to 90%. Though other nucleating agents (ZrC) are equally successful in raising the hydriding yield, the fuel produced exhibits a higher dissociation pressure. The lowest ZrC addition compatible with high yield was found to be 0.7 wt % (0.08 wt % C). However, a modified cycle had to be used, resulting in decreased throughput. The optimum ZrC content, with respect to high throughput and yield, was found to be 1.3 wt % (0.15 wt % C). Melting practice was found to have an effect on hydriding characteristics. Material prepared by nonconsumable-arc-melting techniques has not been successfully hydrided. (auth)

26471 (ORNL-tr-2909) NONLINEAR BEHAVIOR OF CONCRETE UNDER BIAXIAL STRESS. Kupfer, H. B. Translated by R. G. Mansfield, Oak Ridge National Lab., TN, from Beton Stahlbetonbau; 11: 269-274(1973). 14p. Dep. NTIS $4.00.

The behavior of concrete with respect to deformation under biaxial loading can be described with sufficient accuracy with simple mathematical expressions by breaking down the stress and strain state into hydrostatic and deviator components. It then becomes possible to solve nonlinear problems – which until now have been calculated on the basis of constant characteristic values of the material – by introduction of quantities of deformation approximating the actual ones, e.g., by means of the finite elements method. For the calculation with an electronic computer using this method, a so-called rigidity matrix is constructed, which interrelates the quantities force and deformation. An expanded disk equation was derived for variable characteristic values of the material. (auth)

26472 (RLO–2221-T6-20(Rev.)) SPECTROSCOPIC STUDIES OF ACTINIDE IONS IN CRYSTALLINE SOLIDS. Progress Report, October 1, 1973–September 30, 1974. Gruber, J. B. (Washington State Univ., Pullman (USA). Dept. of Physics). 1974. Contract AT(45-1)-2221. 289p. Dep. NTIS $17.50.

Chapters by different authors treat: preparation of UCl_4 from UO_2, interpretation of UCl_4 absorption spectrum, low-temperature magnetic susceptibility of UCl_4, EPR of Np^{4+} in Cs_2ZrCl_6 (octahedral), EPR and crystal structure of monoclinic salts of Tm^{3+}, spin–lattice relaxation of rare earth and actinide ions in crystals, pulse NMR system and membrane models for studying indole and skatole interactions by ^{23}Na NMR, transversely excited-atmospheric pressure gas laser for time-resolved infrared spectroscopy, two-photon spectroscopy of $CaF_2:Eu^{2+}$; electroluminescence in thin films doped with rare earth and actinide ions; and electrical transport properties and magnetic susceptibility of rare-earth sesquisulfides. (DLC)

26473 (RN-S-0534) BEARING RETAINER MATERIALS DEVELOPMENT. Final Report. Dessau, P. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Oct 1969. 93p. Dep. NTIS $7.75.

A series of 50-mm bearing tests were performed in liquid hydrogen with irradiated and unirradiated ball- and roller-bearing retainers fabricated from experimental materials. Several of these materials had been qualified by low- and high-speed wear tests. Results of testing during the current period, indicated that the major objective of the program (i.e., to develop radiation, resistant retainer materials) has been successfully achieved. Results of irradiation and bearing test performance are described. Several new, irradiated, reinforced polymers were tested. Of these, the PBI-glass material performed successfully in every respect, qualifying not only the material but an improved retainer configuration as well. The PBI-graphite roller retainers performed satisfactorily, also qualifying this material as a co-candidate for thrust-bearing-retainer application. Correlations between retainer wear rate and wear-test wear rate was demonstrated. (auth)

26474 (TID/SNA-615) EFFECT OF IRRADIATION IN LH_2 ON BEARING CAGES, BEARING CAGE MATERIALS, AND ACTUATOR SEALS FOR NERVA APPLICATIONS, s110-GTR20-W183. GTR-20A TESTS 37R010, 37R011, and 37R013. Dewey, L.; Brown, D. A.; Carlson, G. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 42p. Dep. NTIS $5.25.

The GTR (Ground Test Reactor)-20A irradiation test was performed at the Nuclear Aerospace Research Facility (NARF), Fort Worth Division of General Dynamics. The objective of the irradiation was to evaluate polymer-based and graphite-based materials and components that are candidates for use in NERVA applications. Test specimens and components were irradiated at cryogenic (LH_2) conditions followed by warming to room temperature. They were returned to ANSC for postirradiation testing. Test procedures and results are presented and discussed. (WHK)

26475 (WANL-TME-1310) GRAPHITE SUBLIMATION STUDIES ON NERVA FUEL. Roesmer, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1965. 35p. Dep. NTIS $4.75.

Declassified 13 Mar 1975.

The sublimation rates of graphite from NERVA fuel have been measured on samples $^7/_8$-inch long, with and without niobium carbide linings in the coolant channels at pressures between $2–4 \times 10^{-4}$ torr over the temperature range from 2573 to 2993°K. The temperature dependence of graphite sublimation from unlined fuel samples is represented by the equation $\log m = 10.53 - (4.19 \times 10^4/T)$, and from lined fuel samples by $\log m = 10.09 - (4.19 \times 10^4/T)$, where m is the sublimation rate in $g/cm^2/s$ and T the temperature in degrees Kelvin. The antilogarithm of the difference of the intercepts in the equations has a value of 2.76 which is identical to the ratio of total surface area to the area of all flat surfaces of any given sample. The value and constancy of this ratio up to 2870°K imply that the niobium carbide lining remains intact below this temperature. Absolute surface areas of fuel samples were measured by a newly developed method using 10.4-year ^{85}Kr and were found to increase considerably upon heating. Sublimation rates based on ^{85}Kr surface area measurements were found to be lower by a factor of 64 when compared with rates based on constant geometrical surface areas. (auth)

26476 ENRICHMENT EFFECTS ON ^{19}F NUCLEAR MAGNETIC RELAXATION RATES IN LIQUID UF_6. Ursu, I.; Demco, D. E.; Simplaceanu, V.; Valcu, N. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 6, 605-612(1974).

The nuclear magnetic relaxation rates T_1^{-1} and T_2^{-1} of ^{19}F nuclei in liquid UF_6 were measured as functions of temperature, frequency and enrichment in ^{235}U. A selective effect of the enrichment on T_2^{-1} and T_1^{-1} was observed. The analysis shows that the indirect scalar coupling between ^{19}F and ^{235}U is the relaxation mechanism responsible for this selectivity, due to the rapid quadrupole relaxation of ^{235}U. Possible use of T_2 measurements in liquid UF_6 for enrichment determinations is suggested. (auth)

26477 MAGNETIC PROPERTIES AND MAGNETIC STRUCTURE OF $ThMn_2Si_2$ AND $ThMn_2Ge_2$. Ban, Z. (Inst. Ruder Boskovic, Zagreb); Omejec, L.; Szytula, A.; Tomkowicz, Z. Phys. Status Solidi (a); 27: No. 2, 333-338(16 Feb 1975).

$ThMn_2Si_2$ and $ThMn_2Ge_2$ were studied using neutron diffraction, X-ray diffraction, and magnetometric techniques. Both the compounds have tetragonal $CeAl_2Ge_2$-type structure. Position parameters z for Si and Ge were determined. $ThMn_2Si_2$ is an antiferromagnet with a Néel temperature of 483 K, and $ThMn_2Ge_2$ exhibits a small ferromagnetic moment of 0.35 μ_B with a Curie temperature of 400 K. The magnetic transition in $ThMn_2Ge_2$ is of first order. The magnetic structures for both compounds consist of ferromagnetic layers perpendicular to the c_0-axis which are antiferromagnetically coupled to adjacent layers. The magnetic moment direction in $ThMn_2Si_2$ is parallel to the c_0-axis, and in $ThMn_2Ge_2$, the magnetic moment is slightly deviated from c_0-axis. It is suggested that conduction electrons play an important role in magnetic interactions. (auth)

26478 PROCESS FOR PRODUCING DEUTERIUM-RICH GAS CONCENTRATE AND TRANSITION METAL-RARE EARTH INTERMETALLIC HYDRIDE-DEUTERIDE. Charles, R. J.; Cech, R. E. (to General Electric Co.). US Patent 3,839,537. 1 Oct 1974. Filed Date 21 Dec 1972. 10p.

A process for producing deuterium-rich gas concentrate and novel transition metal-rare earth intermetallic hydride-deuterides is described. Particles of a T_5RE transition metal-rare earth intermetallic compound are contacted with a hydrogeneous gas in a reaction zone to selectively absorb the hydrogen and deuterium components therefrom forming a hydride-deuteride of the compound. Such contact is continued until absorption of hydrogen and deuterium is substantially complete as indicated by a substantial stabilization of pressure in the reaction zone. The resulting particles of transition metal-rare earth intermetallic hydride-deuteride are desorbed sequentially to produce a deuterium in an amount at least about 0.1% by volume greater than that present initially in the hydrogeneous gas. (auth)

26479 EXPERIMENTAL DETERMINATION OF THE SELF-DIFFUSION COEFFICIENT OF URANIUM HEXAFLUORIDE. Galloway, J. G. Jr. Charlottesville, VA; Univ. of Virginia (1974). 114p. University Microfilms Order No. 75-4689.

Thesis (Ph.D.).

The self-diffusion coefficient of uranium hexafluoride was measured using an experimental method patterned after that of Ney-Armistead. The concentration of $^{235}UF_6$ was determined by the detection of the 185 keV gamma ray emitted by ^{235}U. The value of ρD for UF_6 at 19.92°C was determined to be 212.0 micropoises with an uncertainty of ±1.5 percent. This value of ρD is approximately 2.5 percent less than the value predicted from theoretical calculations which utilized the Lennard-Jones potential. The temperature dependence of ρD over the range 0 to 70°C was determined to vary directly as the viscosity, making the quantity $\rho D/\eta$ independent of temperature as predicted by elementary kinetic theory. Within the uncertainty of this investigation, ρD was determined to be independent of UF_6 pressure and isotopic concentration. (Diss. Abstr. Int., B)

26480 CHANGE IN ELECTRICAL RESISTIVITY OF NUCLEAR GRAPHITE DURING COMPRESSION TESTS AND A MODEL FOR ITS DEFORMATION AND FRACTURE MECHANISM. Eto, M.; Oku, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). J. Nucl. Mater.; 54: No. 2, 245-253(Dec 1974).

The results of the resistivity changes during compression of some nuclear graphites are summarized in order to cast light on the fracture mechanism of the materials; data on pyrolytic graphite and amorphous carbon are also taken into account. It is found that all the graphites investigated show an abrupt increase in resistivity when the applied stress increases to about a half of the fracture stress. Above this stress the non-linearity of the stress-strain curve becomes more pronounced and the formation and growth of optically resolvable cracks occur. A model based on the deformation of cracks and pores on the basal plane is proposed for explaining the change in resistivity and is supported by measurements of the effect of pre-stressing on the Young's modulus, thermal expansion, mercury porosimetry and Knoop micro-hardness of the material. (auth)

26481 ION IMPLANTATION IN SEMICONDUCTORS AND OTHER MATERIALS. Proceedings of the Third Symposium Held at Yorktown Heights, New York, December 11–14, 1972. Crowder, B. L. (Ed.). IBM Research Symposia Series. New York; Plenum Publishing Corporation (1973). 667p. (CONF-721226-; ISBN-0-306-30756-1). $35.00.

This volume contains investigations of ion implantation in silicon, compound semiconductors, metals, and insulators. Main topics are radiation damage, ion and damage distributions, and annealing and electrical behavior of materials following ion implantation. Eighteen papers were selected for inclusion in NSA. (auth)

For abstracts of individual papers see: 26259, 26448–26453, and 26482–26492.

26482 IONIZATION EFFECTS IN SELF-INTERSTITIAL MIGRATION AND IMPLANT DAMAGE ANNEALING IN SILICON. Norris, C. B.; Brower, K. L.; Vook, F. L. (Sandia Labs., Albuquerque, NM). pp 17 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semi-conductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226–.

Attempts were made to induce the charge-state-dependent migration of the silicon self-interstitials (Si_i) presumably produced in a shallow ion implant-damaged Si layer (160 keV O^+, $1 \times 10^{13}/cm^2$, 300°K) by subsequently applying intense ionization from more deeply penetrating but nondamaging electron irradiations (5-20 keV e^-, $7.5 \times 10^{16}/cm^2$, 260-280 K). The samples used had been bulk doped with substitutional aluminum (Al_s). EPR of the aluminum interstitials (Al_i^{++}), which are believed to be produced by replacement of Al_s by Si_i, was monitored to detect Si_i migration into the bulk of the sample. No evidence was found that intense ionization following implantation causes significant enhancement of Si_i migration. This result suggests a conflict between the concept of isolated Si_i thermally stable at 300°K and the hypothesis of an athermal, charge-state-dependent mechanism for Si_i migration. Ionization-stimulated annealing of the vacancy-associated lattice damage resulting from O^+ implantation was also investigated. EPR measurements show that intense ionization at 300°K causes negligible annealing of this damage, despite the fact that significant thermal annealing does occur slightly above 300°K. Results suggest that ionization is not the only factor involved in implant damage annealing or in the puzzling migration of the Si_i. (auth)

26483 INTERNAL FRICTION STUDY OF POINT DEFECTS IN BORON-IMPLANTED SILICON. Tan, S. I.; Berry, B. S.; Frank, W. F. J. (IBM Watson Research Center, Yorktown Heights, NY). pp 19-30 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semiconductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226–.

Four well-resolved internal peaks were observed in boron-implanted silicon, with characteristics which suggest that each peak originates from a separate species of point defect. From information on the symmetry, reorientation kinetics and annealing behavior of the defects, it is concluded that the defects consist of boron and silicon interstitials. Specific assignments are proposed for the atomic configuration and charge state of the defects. (auth)

26484 STRAIN INDUCED EFFECTS ON EPR CENTERS IN SILICON GENERATED BY P^+ ION IMPLANTATION. Matsumori, T.; Kobayashi, T.; Maekawa, H.; Izumi, T. (Tokai Univ., Tokyo). pp 31-38 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semiconductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226–.

Damage distribution in silicon generated by P^+ ion implantation was measured by EPR method. It became clear that the peak position of the distribution of the paramagnetic defect center is always located at about 2/3 of the projected range Rp, where ΔHmsl of the signal begins to increase due to the release of the exchange narrowing effect. The g-value observed in the shorter depths than Rp was 2.0058 ± 0.0005 and is identical to that of the center in the amorphous region. At the stopping region of the implanted ions which is around Rp, an increase in the g-value was observed. It can be interpreted that strains caused by the stresses which the implanted ions exert on the surrounding lattice induce that effect. (auth)

26485 CALORIMETRIC DETERMINATION OF OPTICAL ABSORPTION IN PROTON-BOMBARDED GaAs. Stein, H. J. (Sandia Labs., Albuquerque, NM). pp 39-48 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semi-conductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226–.

In order to distinguish between absorption and scattering as the predominant mechanism for near-band-edge optical attenuation in 400 keV proton-bombarded GaAs, calorimetric measurements of absorption at 1.06 μm were made using a YAG:Nd laser. In addition, the photon energy dependence between 0.25 and 1.25 eV, and isochronal annealing between 30 and 450°C for proton-induced attenuation were investigated. The calorimetric measurements combined with transmittance and reflectance measurements show that absorption is the primary cause of the proton-induced attenuation. Absorption near 1.06 μm is fit approximately by an exponential dependence upon photon energy, and is therefore attributed to band tail states. In contrast, a dependence on the square of the photon energy was observed in other measurements for high fluence Xe ion implantation. Seventy percent of the proton-induced attenuation anneals below 300°C in agreement with previously measured neutron-induced optical attenuation. (auth)

26486 SILICON AMORPHIZATION DURING DIFFERENT MASS IONS IMPLANTATION. Baranova, E. C.; Gusev, V. M.; Martynenko, Yu. V.; Starinin, C. V.; Halibullin, I. B. (Inst. of Atomic Energy, Moscow). pp 59-71 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semi-conductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226–.

Amorphization of silicon single crystals during different mass 80 keV ions bombardment (B^+, C^+, Ne^+, Ar^+, Sb^+) was studied by means of three independent techniques: (1) IR absorption at I,8 μ wavelength (divacancy absorption), (2) IR reflection near a fundamental absorption edge, and (3) electron microscopy and fast electron diffraction. Irradiation was carried out at room temperature. From the analysis of data obtained it can be concluded that two types of disordered regions arise during ion bombardment: (1) amorphous regions (A.R.), and (2) disordered, but still processing crystalline structure regions; which are called the crystalline disordered regions (CDR). In CDR the defect concentration is so high that divacancies do not appear. The defect concentration in CDR gradually increases with the increasing of irradiation dose. When the defect concentration achieves some critical value CDR transforms sharply to an amorphous state. Such an amorphization mechanism prevails for light ions. For heavy ions (Sb^+) amorphization arises mainly from a one-step AR formation. The proposed model of amor-

phization gives the qualitative explanation of dose dependence of refractive index for different ions. (auth)

26487 EFFECT OF ION IMPLANTATION ON THE LATTICE LOCATION OF ARSENIC IN ARSENIC-DOPED Si. Eisen, F. H. (Rockwell International, Thousand Oaks, CA); Haskell, J. D.; Rimini, E.; Mayer, J. W. pp 99-110 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semi-conductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226-.

Bombardment of arsenic-doped silicon with 400 keV helium ions and with 220 keV tellurium ions at 250°C was found to cause arsenic to move off lattice sites, as previously observed for 1.8 MeV helium ion bombardment. The fraction of the arsenic which is off lattice sites approaches a saturation at high fluences which seems to be independent of the energy and type of the bombarding ion and temperature between room temperature and 400°C. The movement of arsenic off lattice sites is caused by defects introduced in the silicon as a result of the bombardment. These defects appear to be capable of diffusing distances greater than 1 μm before causing the off site movement of an arsenic atom. Annealing of the tellurium bombarded samples to 700 to 800°C restores most of the off site arsenic to substitutional positions in the lattice. (auth)

26488 CONCENTRATION PROFILES OF ARSENIC IMPLANTED IN SILICON. Iwaki, M. (Univ., Osaka); Gamo, K.; Masuda, K.; Namba, S.; Ishihara, S.; Kimura, I. pp 111-118 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semiconductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226-.

Concentration profiles of 35 to 130 KeV arsenic ions were measured by means of neutron-activation analysis. The profiles are composed of two parts; one of nearly gaussian shape around the peak concentration region and the other of the nearly exponential shape at the deeper region beyond the peak. The nearly gaussian components agree with the prediction by the LSS theory. The exponential shape was not observed in heavily damaged silicon. The slope of the exponential tail is independent of a dose, substrate temperature and ion energy. It is proposed that this tail is caused by a rapid diffusion process such as interstitial diffusion. (auth)

26489 DETERMINATION OF THE CRITICAL DOSE FOR DIFFERENT MASS IONS IMPLANTED INTO SILICON. Mueller, H.; Schmid, K.; Ryssel, H.; Ruge, I. (Technische Univ., Munich). pp 203-214 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semiconductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226-.

A simple theoretical model for the mass dependence of the critical dose of ion implanted silicon is reported in which the energy into atomic processes is considered as a basic quantity for the determination of the number of displaced target atoms. Backscattering experiments on samples implanted at an energy of 150 keV at low temperatures with B, Ne, P, Kr, Sb are presented. The annealing behavior of damage distributions is investigated both by backscattering of 1.3 MeV He^+ ions and by electrical measurements for the dopant ions B, P, and Sb. A correlation between the different results for the critical dose is evaluated. (auth)

26490 BORON DOPING PROFILES AND ANNEALING BEHAVIOR OF AMORPHOUS IMPLANTED SILICON LAYERS. Ryssel, H.; Mueller, H.; Schmid, K.; Ruge, I. (Technische Univ., Munich). pp 215-224 of Ion Implantation in Semiconductors and Other Materials. Crowder, B. L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semi-conductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226-.

Different possibilities for amorphization of silicon in connection with boron implantation were compared. The methods described are silicon and neon predamage implants, implantation of BF_2-molecules, and implantation of boron at 77K. All implantations show a typical amorphous annealing behavior with a steep increase in activation around 500-650°C without reverse annealing. Depending on annealing temperature and time, doping and mobility profiles were measured. For annealing temperatures below 900°C damage dependent electrical activation occurs with complete activation above 650°C in the recrystallized amorphous layer. All four methods are useful for doping, but mobility after annealing only for cold boron and neon predamage implants approach values corresponding to bulk data. Only in the case of neon predamage implantations can the whole doping profile be placed into the amorphous layer in order to achieve low annealing temperatures. (auth)

26491 DAMAGE PROFILES IN ION-IMPLANTED SEMICONDUCTORS AT LOW (25°K) TEMPERATURES. Boettiger, J.; Davies, J. A.; Morgan, D. V.; Whitton, J. L.; Winterbon, K. B. (Chalk River Nuclear Labs., Ont.). pp 599-609 of Ion Implantation in Semiconductors and other Materials. Crowder, B. L. (Ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semiconductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226-.

The damage profiles of 300-keV Ar^+ implants in Si, GaP, GaAs and InP and of 500-keV Kr^+ implants in Si, GaP and Ge were studied theoretically and experimentally. The profiles were measured using the channeling-effect technique. To minimize any influence of annealing the target was kept at 25°K throughout the implantation and the subsequent back-scattering analysis with 2.0 MeV He^+. Reasonable agreement is obtained between the measured and theoretically calculated damage profiles. (auth)

26492 LATTICE DISORDER PRODUCED IN GaAs BY CADMIUM IMPLANTATION. Grob, J. J.; Ghitescu, A.; Siffert, P. (Nuclear Research Center, Strasbourg). pp 611-619 of Ion Implantation in Semiconductors and other Materials. Crowder, B. L. (Ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on ion implantation in semi-conductors and other materials; Yorktown Heights, New York, USA (11 Dec 1972). See CONF-721226-.

The backscattering technique was used to investigate the lattice disorder produced by implanting 20-60 keV cadmium ions into gallium arsenide. Special emphasis is given to the interpretation of the spectra. It is shown that previous interpretations of the backscattered spectra on compound semiconductors are incorrect, especially concerning the determination of the random level. (auth)

26493 DOMAIN WALL DYNAMICS IN FERROELECTRIC/FERROELASTIC MOLYBDATES. Flippen, R.B. (Central Research Department, E. I. du Pont de Nemours and Company, Wilmington, Delaware 19898). J. Appl. Phys. 46: No. 3, 1068-1071 (Mar 1975)

The effects of electrical field and mechanical stress on domain wall motion have been quantitatively determined for gadolinium molybdate (GMO) and similar compounds. The ratio of the stress driven wall mobility μ_σ to the electrical field driven wall mobility μ_E is shown to be equal to the ratio of the spontaneous strain γ_0 to the spontaneous polarization P_0 and to have the numerical value 1.53×10^4 cm^2/C. The dynamics of domain wall motion in GMO are discussed in relation to the crystal structure of this material. (auth)

26494 ELECTRON MICROSCOPY OF FINE HOLES IN POLYETHYLENETEREPHTHALATE FILMS IRRADIATED BY FISSION FRAGMENTS. Komaki, Y.; Otsu, H.; Izui, K.; Tsujimura, S. (Division of Chemistry, Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken, Japan). J. Appl. Phys. 46: No. 3, 1155-1158 (Mar 1975).

Fine holes in polyethyleneterephthalate films prepared by exposing to fission fragments and chemical etching were observed with an electron microscope. Transmission electron micrographs of the films 6-9 μm in thickness were taken using a high-voltage electron microscope. Hole densities and hole diameters were determined and found to agree with the values calculated from the irradiating condition and those obtained from the measurements of gaseous diffusion through the films, respectively. (auth)

26495 POSITRON ANNIHILATION IN ALKALI-HALIDE CRYSTALS AFTER ELECTRON IRRADIATION. Vorobiev, A. A.; Arefiev, K. P.; Vorobiev, S. A. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). Appl. Phys.; 3: No. 3, 241-243(Mar 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

The effect of electron beam irradiation on positron annihilation in KCl, KBr, NaCl single crystals was investigated. The narrowing of the angular correlation curves increases up to the saturation value with the absorbed radiation dose. The shape of the received narrow components differs from the narrow component measured in the additively colored samples. This phenomenon shows the considerable influence of the hole centers upon positron annihilation in ionic crystals. (auth)

26496 THERMO EMF AND ELECTROCHEMICAL POTENTIALS OF ZIRCONIUM HYDRIDES. Aslanova, T. S.; Ivashina, G. A.; Nemchenko, V. F.; Pigida, S. D.; Fomina, L. R. (Khersonskij

Pedogological Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 60-63(1973). (In Russian).

The temperature (100 to 400°K) and the concentration dependence of the thermo emf coefficient and of the discontinuity of the electrochemical potential were studied for zirconium hydrides. The results were discussed under the assumption of a maximum density of the electron state during the change of the hydrogen concentration in the hydride. It was concluded that there is partial positive ionization of the hydrogen atoms during their introduction into the metal lattice. (tr-auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

26497 (HEDL-TME-74-59) FFTF FUEL PIN NONDESTRUCTIVE ASSAY MEASUREMENTS. Summary Technical Report, FY-1974. Goris, P. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1974. Contract AT(45-1)-2170. 42p. Dep. NTIS $4.00.

Plutonium fissile assay results by a ^{252}Cf fuel pin scanner on initial FFTF fuel pin shipments showed systematic differences with vendor chemical assay values. New fuel pin standards were prepared to investigate systematic differences and to evaluate fuel pin scanner results with vendor chemical assay results on pin-to-pin, lot-to-lot, and shipment bases. The limit of error for neutron well coincidence counting of fuel pellets was established. A mapping study of the neutron well response was completed. (auth)

26498 (REG/G-5.47(2-75)) CONTROL AND ACCOUNTABILITY OF PLUTONIUM IN WASTE MATERIAL. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 5p. NRC.

This guide describes gamma and neutron assay procedures that are acceptable to the Regulatory staff for control and accountability of plutonium-contaminated waste. (TFD)

26499 (REG/G-5.48(2-75)) DESIGN CONSIDERATIONS SYSTEMS FOR MEASURING THE MASS OF LIQUIDS. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 6p. NRC.

Measurement of the special nuclear material (SNM) content of a vessel containing a homogeneous liquid solution consists of three principal operations: (1) measurement of liquid mass (either by weighing directly or by measuring the volume, temperature, and specific gravity); (2) obtaining a representative sample of the vessel contents; and (3) assay of the sample to determine the SNM concentration in terms of unit weight or unit volume. This guide deals with measurement activities that are affected by vessel design. Proper attention to design makes possible more accurate measurement of the solution bulk. It also improves the ease of achieving accurate bulk measurements and obtaining representative samples. The determination of chemical and isotopic concentrations in samples by traditional analytical techniques is independent of vessel design, and chemical and isotopic assay are not discussed in this guide. (auth)

26500 (WANL-TME-1096) PROGRAM FOR RESOLUTION OF SHIPPER-RECEIVER DIFFERENCES. Progress Report No. 2. Holmgren, J. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Jan 1965. 51p. Dep. NTIS $5.75.

Declassified 13 Mar 1975.

This is the second progress report summarizing the results which were obtained during the current report period on the Westinghouse Astrofuel Accountability Check Program. This report covers the period Dec. 14, 1964 through Jan. 15, 1965. During this period, particular emphasis was placed on analytical evaluation of the process scrap, completing material balances for various process operations, and critically examining the various process loss categories. The results of these efforts are summarized. (auth)

26501 NUCLEAR SAFEGUARDS. Nucleonics Week Special Report. New York; McGraw-Hill, Inc. (1974). 15p.

A collection of newsworthy items concerning safeguarding of nuclear materials appearing in Nucleonics Week during 1974 is presented. (TFD)

Disposal and Storage

Refer also to abstracts 26507, 25222, 25497, and 25792.

26502 (BNWL-1876) NUCLEAR WASTE MANAGEMENT AND TRANSPORTATION QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1974. Dau, G. J. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1974. Contract AT(45-1)-1830. 92p. Dep. NTIS $5.45.

Nine sections comprise this report: advanced methods for management and disposal of radioactive wastes; separation of actinide elements from radioactive waste; decontamination and densification of chop-leach cladding residues; waste treatment and handling processes; tritium separation and fixation; characterization of 300 area and Wye burial grounds; disposition of retired, contaminated (future WMT) facilities at Hanford; development of packaging technology for $Pu(NO_3)_4$ shipment; and transportation safety studies. A separate abstract was prepared for each section. (LK)

For abstracts of individual sections see: 25334–25337, 25792, 26503, 26504, 26514, and 26515.

26503 (BNWL-1876, pp 1-43) ADVANCED METHODS FOR MANAGEMENT AND DISPOSAL OF RADIOACTIVE WASTES. Schneider, K. J. Nov 1974.

In nuclear waste management and transportation quarterly progress report, July–September 1974.

The objective of this program is to systematically assess alternative systems for management of radioactive wastes resulting from nuclear fuel cycle alternatives. The information gained from these assessments will be used to develop a rationale and methodology for assistance to the eventual formulation of a comprehensive R&D plan for management and disposal of nuclear fuel cycle wastes. (auth)

26504 (BNWL-1876, pp 77-80) DISPOSITION OF RETIRED, CONTAMINATED (FUTURE WMT) FACILITIES AT HANFORD. Harmon, K. M. Nov 1974.

In nuclear waste management and transportation quarterly progress report, July–September 1974.

The program has the following objectives for FY75-76: to establish methods, costs and priorities for the disposition of retired (excessed) Hanford facilities which will be transferred to WMT; to formulate plans and specifications for a project to accomplish permanent disposal of a specific Hanford facility; and to identify required facility disposition R&D. (auth)

26505 (ICP-1044) EVALUATION OF HIGH PRESSURE STEEL CYLINDERS FOR FISSION PRODUCT NOBLE GAS STORAGE. Foster, B. A.; Pence, D. T. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). Feb 1975. Contract AT(10-1)-1375. 19p. Dep. NTIS $4.00.

The collection and long-term storage of ^{85}Kr will be required to prevent potential local release problems at reprocessing plants and global accumulation in the atmosphere as new plants go on stream. The advantages and disadvantages of using high pressure steel cylinders for long-term storage of ^{85}Kr are discussed. The advantages are: (1) well-established history of development and use in industry, (2) long life with good thermal and radiation resistance, (3) high capacity, (4) low cost, and (5) ease of future recovery. The disadvantages are: (1) the potential for sudden failure of a cylinder resulting in the release of its contents, (2) the requirements that are placed on the purity of the gas to be stored, and (3) potential problems arising from the presence of the decay product rubidium. The disadvantages do not appear to be serious enough to preclude the use of high pressure steel cylinders for the long-term storage of ^{85}Kr. (auth)

26506 WASTE HANDLING AND TRANSPORT. Nucleonics Week Special Report. New York; McGraw-Hill, Inc. (1974). 15p.

A collection of newsworthy items on the handling and transport of radioactive wastes that appeared in Nucleonics Week during 1974 is presented. (TFD)

Handling Equipment and Procedures

26507 (RN-S-0007) DECONTAMINATION FACILITY AND WARM EQUIPMENT AND PARTS STORAGE FACILITY. Design Criteria. (Aerojet-General Corp., Azusa, Calif. (USA)). Feb 1964. 91p. Dep. NTIS $7.75.

Data are presented on the design criteria for a Warm Equipment and Parts Storage Facility to provide for concurrent NRX and E-engine programs, a general Decontamination Facility and the electric power supply for the entire Radioactive Materials Handling Decontamination and Storage Complex. These facilities are to be located at the Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada. (auth)

26508 (SLA-74-0271) CRITICALITY EVALUATION OF THE ACPR FUEL-ELEMENT STORAGE RACK. Estes, B. F.; Morris, F. M.; Philbin, J. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. Contract AT(29-1)-789. 63p. Dep. NTIS $6.25.

The storage rack for standard fuel elements used in the Sandia Annular Core Pulse Reactor has been subjected to a series of mea-

surements to demonstrate its criticality safety aspects. This report describes the measurements and presents the results of an analytical evaluation of criticality factors for the storage rack. (auth)

26509 (WANL-TME-245) NRDS RADIOACTIVE MATERIALS HANDLING, DECONTAMINATION AND STORAGE COMPLEX. Wood, T. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Jan 1963. 5p. Dep. NTIS $4.00.

The preliminary data and gross flow diagrams to allow for scoping of the work and the understanding of the problems associated with the handling, decontamination, storage and disposal of radioactive materials resulting from the testing and post-operative examinations of NERVA engine cores are presented. (auth)

26510 NEW POST-IRRADIATION LABORATORY AT THE CASACCIA CENTER. Serge, G. (CNEN, Casaccia, Italy). Com. Naz. Energ. Nucl., Notiz.; 20: No. 12, 39-42(Dec 1974). (In Italian).

The network planning technique (PCS system) has been applied as a support to the management of the design, construction and setup of the new post-irradiation laboratory at the CSN Casaccia Center. A description of the work carried out in three years, and comments, are reported. (auth)

26511 NEW HOT CELLS OF THE CASACCIA CENTER. Busoni, L.; Carinci, E.; Cesarano, C.; Evangelisti, R.; Lauro, M.; Naticchioni, A.; Nicolucci, G.; Vescia, G. (CNEN, Casaccia, Italy). Com. Naz. Energ. Nucl., Notiz.; 20: No. 12, 27-37(Dec 1974). (In Italian).

The design and construction of a new alpha-gamma hot laboratory at the Casaccia Nuclear Center are described. The laboratory includes high and medium-activity cells and related facilities for a comprehensive post-irradiation program on plutonium fuel elements irradiated either in research reactors or in power stations. (auth)

26512 METHOD AND APPARATUS FOR HANDLING AN IRRADIATED FUEL ASSEMBLY. Shallenberger, J. M.; Meuschke, R. E.; Desmarchais, W. E. (to Westinghouse Electric Corp.). US Patent 3,863,770. 4 Feb 1975. Filed date 11 Apr 1973. 8p.

A method and apparatus is disclosed for handling an irradiated fuel assembly during underwater transfer operations. In moving from one underwater storage fixture to another, the irradiated fuel assembly is supported by primary and redundant supporting means. In the unlikely event the primary supporting means fails the redundant supporting means operates to control the rate of descent of the irradiated fuel assembly to prevent damage thereto. (Official Gazette)

26513 CRITICALITY OF PERIODICALLY BORON-POISONED ENRICHED URANIUM SOLUTION SYSTEMS. Rothe, R. E.; Alvarez, D. L.; Clark, H. E. (Dow Chemical U. S. A., Golden, CO). Contract AT(29-1)-1106. Nucl. Technol.; 25: No. 3, 502-516 (Mar 1975).

Nuclear safety engineers must evaluate the criticality potential of a variety of plant problems. Many of these involve an essentially unreflected system containing a uranium solution and a fixed nuclear poison. Measured critical parameters for such a system at solution concentrations of 52.2- and 141.5-g U/liter, together with those reported previously at 450.8-g U/liter, provide the engineer information over a wide range of concentrations normally encountered in industrial applications. The uranium was enriched to 93.24 wt % ^{235}U. The fixed poison was 1.02 wt % natural boron alloyed in stainless-steel plates. Critical solution heights were measured for various numbers of nearly uniformly spaced vertical plates within the 106.6-cm-dia experimental tank. The simplest cases studied involved no poison, resulting in low critical heights. As plates were added, the critical height increased until a sufficient number were present that even an infinitely tall tank would have been subcritical. The actual finite plate height permitted a third type of experimental result; the critical parameters of an unpoisoned uranium solution slab on top of a highly poisoned solution region. Experimental data at all three concentrations compared with results from Monte Carlo and neutron transport computer codes are found to predict critical heights consistently in excess of measured values. A nuclear safety engineer may safely apply these calculational methods to similar plant situations provided an ~20% reduction in either the solution height or plate spacing—whichever is appropriate—is made to account for the theory/experiment difference. Boron-containing plates are compared with borosilicate glass Raschig rings as fixed nuclear poisons for large-volume solution storage. Neither is clearly superior to the other considering the poison volume percent required for criticality. Nuclear safety engineers may safely apply these experimental poison plate data to standard ring-poisoned systems involving a high-concentration uranium solution provided a 2% increase in the boron density is made to account for uncertainties in the comparison. (auth)

Transportation

26514 (BNWL-1876, pp 81-83) DEVELOPMENT OF PACKAGING TECHNOLOGY FOR $Pu(NO_3)_4$ SHIPMENT. Brown, C. L. Nov 1974.

In nuclear waste management and transportation quarterly progress report, July–September 1974.

The USAEC has announced that the shipment of $Pu(NO_3)_4$ solution will be prohibited as of June 17, 1978. After that date, the only solid Pu form that can be shipped to fuel fabricators as a plutonium fuel material is PuO_2. The objectives of this program are: 1. To determine if a solid form of plutonium nitrate can be found that is reasonably stable and directly soluble in nitric acid; 2. To define new packaging technology for the shipment of the solid plutonium form; and 3. Based on the success of (1 and 2) to define a commercially feasible process to make the solid plutonium form. If plutonium nitrate in powder form can be stored and shipped safely, made economically, and is readily soluble in nitric acid, then plutonium nitrate powder is likely to be superior to PuO_2 for shipment to plutonium fuel fabricators. The compounds currently under investigation are $Pu(NO_3)_4 \cdot XH_2O$, $K_2Pu(NO_3)_6$ and $(NH_4)_2Pu(NO_3)_6$. (auth)

26515 (BNWL-1876, pp 85-87) TRANSPORTATION SAFETY STUDIES. Williams, L. D. Nov 1974.

In nuclear waste management and transportation quarterly progress report, July–September 1974.

The objective of the transportation safety study program is to develop and use a model for calculating the risks associated with the shipping of radioactive materials. (auth)

26516 (CONF-750411-1) TESTING OF LARGE, OBSOLETE SHIPPING CASKS. Shappert, L. B.; Evans, J. H. (Oak Ridge National Lab., Tenn. (USA)). 1975. 9p. Dep. NTIS $4.00.

From European nuclear conference; Paris, France (21 Apr 1975).

The obsolete cask testing program was initiated to study the behavior of casks under specified test conditions and to establish the adequacy of calculational techniques which are presently employed to predict cask damage. The test used to produce severe cask damage consists of a free fall by the cask from an elevation of 30 ft and impacting on an essentially unyielding surface in several different orientations. Several lead-shielded, steel-jacketed casks have been chosen to be tested in this program. The initial tests were performed on two casks weighing 6000 and 6200 lb which were formerly two sections of a long cask not originally designed to meet the accident criteria required for off-site shipments. The initial drop tests had two primary purposes, the first of which was to test the instrumentation used to provide dynamic measurements during the impact and to determine if this instrumentation is adequate for the tests of larger casks to follow. Second and of equal importance, was the need to collect physical measurements of the cask before and after the drop to compare against predicted changes. The experimentally determined and calculated responses of the test casks were in sufficient agreement to warrant continued use of the basic calculational methods employed. It should be noted that methods currently used in predicting damage are not always conservative and consequently, there may be a need to add a small margin of safety to current predictions. Certainly improvements in current analysis methods can be made as a result of a better understanding of the modes in which large casks might fail. It is apparent that welds need to be of high quality if they are to withstand the severe impact required by the regulations without rupture. (TFD)

26517 (ORNL-TM-4602, pp 259-262) SHIPPING STUDIES. Ulrich, W. C. Dec 1974.

In experimental engineering section semiannual progress report (excluding reactor programs) September 1, 1973–February 28, 1974.

The design of a package for shipping plutonium nitrate solutions expected to be obtained in the future from the reprocessing of high-burnup power reactor fuel was completed, and fabrication of a prototype package for use in a testing program was begun. (auth)

26518 (RDT-E-12-5T(1-75)) OPERATING MANUALS FOR FUEL SHIPPING CONTAINERS. (USERDA Division of Reactor

Research and Development, Washington, D. C.). Jan 1975. 15p. RSO.

This standard prescribes the preparation and distribution of operating manuals for use, maintenance, and inspection of type B packaging for shipping reactor fuel and irradiations experiments. (TFD)

26519 (RDT-E-12-7T(1-75)) INSPECTION AND PREVENTIVE MAINTENANCE OF FUEL SHIPPING CONTAINERS. (USERDA Division of Reactor Research and Development, Washington, D. C.). Jan 1975. 9p. RSO.

This standard provides requirements for the performance of inspections and preventive maintenance to ensure that packaging continues to meet original design specifications and is properly assembled for shipment. The standard applies to: (1) fuel shipping containers which are within the scope of AEC Manual Chapter 0529, or Code of Federal Regulations, Title 10, Part 71; (2) inserts or other packaging components required in accordance with the safety analysis report–packages (SARP), the certificate of compliance, and any amendments thereto; (3) tiedown devices to and including point of attachment to the transport vehicle; and (4) ancillary features (sun shields, crash frames, impact absorbers, lifting yokes) required by the conditions of shipment or required for safe handling of the packaging. (TFD)

26520 (RDT-F-8-9T(2-75)) DESIGN BASIS FOR FUEL AND IRRADIATIONS EXPERIMENT RESISTANCE TO SHOCK AND VIBRATION IN TRUCK TRANSPORT. (USERDA Division of Reactor Research and Development, Washington, D. C.). Feb 1975. 8p. RSO.

This standard specifies minimum design values for shock and vibration in highway transport, by truck or tractor-trailer, for fuel and irradiation experiments when package weight exceeds one ton. Shock values correspond to normal transport over rough roads and to minor accidents causing only body damage to the vehicle. Vibration values correspond to normal transport; any large amplitude vibration resulting from a minor accident is treated as shock. The standard includes recommended methods of application to the design of packaging and tiedown systems. It is applicable to evaluating effects of shock and vibration during truck transport of packages weighing more than one ton and containing fuel and irradiations experiments. These may include unirradiated fuel pins and subassemblies, instrumented test trains, and other devices with fissile or radioactive content. The standard is intended for application in cases where damage in shipment would cause unacceptable cost penalty or programmatic delay. (TFD)

26521 (WANL-TME-1094) TEST OF FUEL ELEMENTS IN THEIR TRANSPORTATION CONTAINER (EML-72). Gyurek, J. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1965. 14p. Dep. NTIS $4.00.

A test was performed to determine the extent of fuel element damage as a result of inter-plant truck shipment, to evaluate handling and shipping procedures, and to define the shipping environment. No fuel element damage occurred during this test but improved shock and vibration isolation for the shipping container was recommended, and vibration tests for insuring the integrity of new designs of shipping containers are proposed. (LCL)

26522 (Y-KC-94) EVALUATION OF A SHIPPING CONTAINER FOR NINE UNIRRADIATED ROVER FUEL ELEMENTS. Crume, E. C.; Pletz, R. H. (Oak Ridge Y-12 Plant, Tenn. (USA)). 12 May 1967. Contract W-7405-eng-26. 29p. Dep. NTIS $4.50. Declassified 21 Nov 1974.

A shipping container design for the shipment of small quantities of unirradiated Rover fuel elements has been evaluated against the fissile material packaging standards given in AEC Manual Chapter 0529. Based on the results of an engineering analysis, mechanical testing of prototypes, and an associated nuclear criticality safety analysis, the container was found to meet the standards given in Chapter 0529 for a Fissile Class II package, subject to the following loading restrictions: for class II shipments, each container is to be loaded with no more than 9 elements; and the maximum uranium content of an element is not to exceed 346 grams, the uranium loading is not to exceed 1200 mg/cm^3, and the carbon-to-uranium atomic ratio is not to be less than 33 to 1. A nine-element shipping container loaded so as to satisfy these restrictions is to be assigned 0.5 radiation unit. (auth)

26523 A CONTAINER FOR TRANSPORTING IRRADIATED FUEL ELEMENTS HAVING A HIGH RESIDUAL ENERGY. (to CEA, 75-Paris (France)). French Patent 2181540/A/. 27 Apr 1972. 8p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A container is described for transporting radioactive substances capable of emitting gamma and neutron radiations. A containment envelope is surrounded by a gamma protective lead sheath contained in an intermediate jacket provided with cooling members; a neutron protective outer envelope is made integral with said intermediate jacket by means of removable mechanical linkages; the outer envelope is provided with longitudinal ports for the circulation of air. The container according to the invention can serve as a container for radioactive substances forming a heat-source, the thermal energy of which has to be discharged into the atmosphere. (FR)

26524 A DEVICE FOR THE AIR-COOLING OF RADIOACTIVE PRODUCTS CONTAINERS. (to Etablissements Lemer et Compagnie, 44-Nantes (France)). French Patent 2179672/E/. 14 Apr 1972. 10p. (In French).

Addition to the French patent document 7141937; available from Institut National de la Propriete Industrielle, Paris (France).

On the container periphery, two walls contain the neutronic shield. These walls are joined by strips. These strips are welded to the wall and tin-plated. Sleeve comprises several portions clamped on the tin-plated parts (or it is expanded, then clamped on the tin-plated parts). The neutronic shield (e.g., polyethylene) is introduced between the strips. The latter can be exchanged for tubes. Heat is thus transferred toward sleeve. (FR)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 25903.

26525 (GSI-J1-74) PARTICLE ACCELERATORS IN THE FRG. Hartwig, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Oct 1974. 44p. (In German). INIS.

The present compilation is the result of an inquiry about particle accelerators in the Federal Republic of Germany. It gives the status up to approximately 1st May 1974. All machines reaching an energy of at least 3 MeV for protons or electrons with exception of all betatrons are considered. The Van-de-Graaff accelerators which come into the 3 MV region by upgrading from the 2 MV terminal voltage region are also not considered. The compilation is to be of use to potential users for giving information on irradiation possibilities with charged particles in the Federal Republic. Following a summary of the essential characteristics of the machines described in the form of tables for a better direct comparison, the machines are individually presented, whereby particular attention is paid to additional arrangements which do not belong to the standard equipment of the accelerator laboratory. An attempt is made to evaluate all data possible which the operators have put to the inquiry. However the completeness and correctness of these data cannot be guaranteed. (auth)

26526 (JINR-P9-8486) INVESTIGATION OF THE VARIABLE MAGNETIC FIELD SCREENING BY CONDUCTING SCREENS. Derendyaev, Yu. S.; Ivanov, I. N.; Kaminskii, A. K.; Kaminskaya, A. M.; Lachinov, V. M.; Makoveev, V. K.; Rashevskii, V. P.; Rubin, N. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1974. 18p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The problems of the screening of a variable magnetic field by a disc with holes with cylindircal surfaces of the chamber and their combinations are discussed. The experimental results are presented. The technique of computation is given. The mentioned technique allows one to calculate the magnetic field taking into account the screens of different forms in the axial symmetry limits. The problem is studied in connection with the shielding of external fields at electron-ring accelerators. (auth)

26527 (KFK-2058) TRANSVERSE AND LONGITUDINAL BEAM MATCHING TO A SUPERCONDUCTING LINEAR PROTON ACCELERATOR. Zieher, K. W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Dec 1974. 105p. (In German). Dep. NTIS (US Sales Only) $8.25.

Thesis. Submitted to Karlsruhe Univ., West Germany.

A superconducting prototype linear proton accelerator is being built at the Kernforschungszentrum at Karlsruhe. A high-voltage cascade generator with a duoplasmatron source for protons is available as an injector. A transverse and longitudinal beam matching system has been developed and investigated both experimentally and theoretically. The phase space volume of the experimental beam pulses fits into the given transverse and longitudinal acceptance of the linear accelerator. The beam chopping principle is different from the conventional method. Both measurements and calculations show that beam pulses can be produced according to this principle which occupy a longitudinal phase space volume smaller than the known theoretical lower limit for a conventional chopper. (auth)

26528 (LUNP-7404) VdG-ACCELERATOR AT LUND, 1950–1974. Hellborg, R. (Lund Univ. (Sweden). Fysiska Institutionen). Apr 1974. 26p. (In Swedish). Dep. NTIS (US Sales Only) $4.50.

The construction of the VdG-accelerator at Lund is based on a prototype developed by Professor R. G. Herb of Wisconsin, USA. It is horizontal design which is convenient for construction and maintenance. Construction, modification and experimental working during the period 1950 to 1974 is described in detail, chronologically, as a permanent record as it is now being replaced by a new accelerator supplied by a commercial firm. The new 3 MV accelerator is briefly described. A terminal voltage of 3 MV will enable 6 MeV protons, 6 MeV deuterons and 9 MeV He-ions to be obtained. (SW)

26529 (TRITA-EPP-74-16) ACCELERATING PARTICLES IN THE MICROTRON BY NON-SINUSOIDAL FIELD. Rosander, S. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Elektronfysik). Sep 1974. 36p. Dep. NTIS (US Sales Only) $5.00.

Large phase-stable areas can be obtained if a microtron is driven by an rf field with non-sinusoidal time variation. The theory of the proposed principle is given and an experiment at the 7 MeV microtron in Stockholm is described. (auth)

26530 THE 14UD PELLETRON ACCELERATOR AT THE AUSTRALIAN NATIONAL UNIVERSITY. Ophel, T. R.; Harrison, J. S.; Newton, J. O.; Spear, R. H.; Titterton, E. W.; Weisser, D. C. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Nucl. Instrum. Methods; 122: No. 1-2, 227-234(15 Nov 1974).

The 14UD accelerator which has been installed at Canberra is currently undergoing acceptance testing. Beams of protons and chlorine have been accelerated with terminal voltages of 14 MV. The installation is described and the operational experience to data summarized. (auth)

26531 THE NUCLEAR STRUCTURE FACILITY AT DARESBURY. Aitken, T. W.; Halliday, B. S.; Johnstone, W. T.; Jones, C. W.; Joy, T.; Morris, M. C.; Tait, N. R. S.; Voss, R. G. P. (SEE CODE-5677740 Science Research Council, Daresbury (UK). Daresbury Nuclear Physics Lab.). Nucl. Instrum. Methods; 122: No. 1-2, 235-265(15 Nov 1974).

The 30 MV tandem accelerator at present under construction at Daresbury is described. Included are the beam optics of the machine, the accelerator stack design and the pressure vessel, gas handling and vacuum system. A description is given of the control system proposed for the accelerator. The extensive and continuing research and development program which is under way at the Laboratory is outlined. (auth)

26532 PELLETRON ACCELERATORS FOR VERY HIGH VOLTAGE. Herb, R. G. (National Electrostatics Corporation, Middleton, Wisconsin, U. S. A.). Nucl. Instrum. Methods; 122: No. 1-2, 267-276(15 Nov 1974).

The design features of the NEC Pelletron accelerators are presented and discussed. Particular attention is directed toward identification of those aspects of existing electrostatic accelerators which limit ultimate voltage performance and to progress which has been made toward eliminating or deferring these limitations. (auth)

26533 VAN DE GRAAFF ACCELERATORS OF THE FUTURE. Goldie, C. H.; Trump, J. G. (High Voltage Engineering Corp., Burlington, Mass. (USA)). Nucl. Instrum. Methods; 122: No. 1-2, 277-285(15 Nov 1974).

The prospect of achieving multi-stage electrostatic accelerators with constant terminal potentials of 50 MV for attaining heavy particle energies in the BeV range was envisaged and urged by Van de Graaff for many years. The High Voltage Engineering Corporation has advanced these concepts by progressively increasing the voltage and gradient capabilities of its accelerators and by providing improved tube, resistor and column components for upgrading existing systems. Test results are reported on the XTU 2-stage tandem which has insulated over 20 MV on its terminal and 16 MV with recently installed acceleration tubes. A prospective design for a 40 MV Van de Graaff is outlined and the comparative merits and problems of insulating and conductive charge carriers for such systems are discussed. (auth)

26534 THE UNIVERSITY OF WASHINGTON THREE-STAGE TANDEM VAN DE GRAAFF ACCELERATOR. Weitkamp, W. G.; Schmidt, F. H. (Washington Univ., Seattle (USA)). Nucl. Instrum. Methods; 122: No. 1-2, 65-79(15 Nov 1974).

The 3-stage Model FN Tandem Van de Graaff accelerator at the University of Washington and its operating characteristics are described. With the 3 stages, the machine produces proton and deuteron beams up to 0.6 μA in intensity at energies up to 25.5 MeV. The neutral-negative system is now being replaced with a terminal source so as to increase the energy and versatility of the 3-stage configuration. Various improvements to the accelerator and the ancillary equipment have been made since initial operation (1965). These include new ion sources, a polarized ion source, beam stabilization systems, and miscellaneous other equipment. Maintenance problems and procedure are also discussed. The accelerator combination has proved to be a versatile and relatively reliable instrument for a wide variety of nuclear research. (auth)

26535 THE LOS ALAMOS THREE-STAGE VAN DE GRAAFF FACILITY. Woods, R.; McKibben, J. L.; Henkel, R. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 122: No. 1-2, 81-97(15 Nov 1974).

The LASL three-stage accelerator facility is described in detail. The history and development of the large vertical Van de Graaff is covered up to the present configuration. The changes that have been made in the FN tandem as compared to the standard machine are described. Operating characteristics are given for both machines operating independently and in the series configuration. The facilities and equipment available for experiments are enumerated. Three-stage acceleration of tritons is discussed at length as an example of the facility's capabilities. (auth)

26536 AN OPERATIONAL REVIEW OF THE TUNL CYCLO-GRAAFF. Newson, H. W.; Bilpuch, E. G.; Purser, F. O.; Boyce, J. R.; Clegg, T. B. (Triangle Universities Nuclear Lab., Durham, N. C. (USA)). Nucl. Instrum. Methods; 122: No. 1-2, 99-113 (15 Nov 1974).

The Cyclo-Graaff accelerator pioneered at TUNL is reviewed after five years of operating experience. The concept has proved successful and led to the development of a laboratory capable of a very wide range of experimental programs. Characteristics of Cyclo-Graaff operation are discussed with examples given of experimental results obtained. Additional experimental capabilities of the laboratory are briefly reviewed. (auth)

26537 THE A.N.U. 26 MeV CYCLOTRON INJECTOR. Ophel, T. R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Nucl. Instrum. Methods; 122: No. 1-2, 115-118(15 Nov 1974).

A negative-ion cyclotron injector, capable of producing 26 MeV H^- or 14.2 MeV D^- beams, has been in operation with the A. N. U. EN tandem accelerator for nearly two years. Operational experience and beam characteristics are described briefly. (auth)

26538 SOME TANDEM ACCELERATORS IN THE SOVIET UNION. Hochberg, B. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii); Mikhailov, V. D. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)); Romanov, V. A. (Institute of Physics and Power Engineering, Obninsk, U.S.S.R.). Nucl. Instrum. Methods; 122: No. 1-2, 119-128(15 Nov 1974).

The basic physical specifications of the model EGP-10 and EGP-20 tandem accelerators are given and their design features described. The construction and performance parameters of the basic accelerator components are considered and possibilities for further improvement of their characteristics are estimated. Comparison between the guaranteed and achieved parameters of the EGP-10 is made. (auth)

26539 PERFORMANCE AND OPERATIONAL CHARACTERISTICS OF THE YALE TANDEM ACCELERATOR. Sato, K.; Benjamin, J. A.; Gingell, C. E. L.; Parker, P. D.; Bromley, D. A. (Yale Univ., New Haven, Conn. (USA). Nuclear Structure Lab.). Nucl. Instrum. Methods; 122: No. 1-2, 129-142(15 Nov 1974).

The MP-1 tandem Van de Graaff accelerator which was initially commissioned at Yale in 1966 is presently being converted to higher gradient operation. In April 1973 the charging belt was replaced by six Pelletron chains; the installation of a newly designed set of stainless-steel electrode acceleration tubes is currently in progress. This paper summarizes performance data and operational experience gained with the original MP-1 facility and the Pelletron charging system; it also discusses the characteristics and design of the more recent conversion modifications. (auth)

26540 CONSTRUCTIONAL CHANGES MADE TO THE MINNESOTA MP TANDEM VAN DE GRAAFF ACCELERATOR. Broadhurst, J. H.; Blair, J. M. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). Nucl. Instrum. Methods; 122: No. 1-2, 143-146(15 Nov 1974).

Since initial operation of the Minnesota MP tandem Van de Graaff accelerator began in 1966 a number of changes have been made to prevent recurring faults and to improve machine performance. A description of these modifications to the mechanical and electrical structure of the machine and the resulting improvements in performance are summarized. A preliminary report on the operation of accelerator tubes of a modified design is included. (auth)

26541 THE CHALK RIVER MP TANDEM FACILITY: SPECIAL FEATURES AND OPERATING EXPERIENCE BEFORE AND AFTER UPGRADING. Andrews, H. R.; Burn, N.; McDonald, A. B.; Milton, J. C. D.; O'Dacre, J. P. D. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Instrum. Methods; 122: No. 1-2, 147-158(15 Nov 1974).

Characteristics of the Chalk River MP tandem accelerator both in its original configuration, and following upgrading with the first of the Mark I, HVEC kits, are presented and discussed. A number of unexpected difficulties encountered during the upgrading program are analyzed and their solutions reported. Particular problems were identified as reflecting anomalous dust deposition from HVEC black belts and pumping of oxygen gas by the stainless steel electrodes of the Mark I acceleration tubes. (auth)

26542 THE UNIVERSITY OF ROCHESTER MP TANDEM UPGRADING PROGRAM. Purser, K. H.; Grove, H. E.; Lund, T. S. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.); Hyder, H. R. M. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Instrum. Methods; 122: No. 1-2, 159-177 (15 Nov 1974).

The recently completed upgrading program carried out on the University of Rochester MP Tandem Van de Graaff accelerator is described. The principal features involve new, small diameter, spiral tilt accelerator tubes, separate tube and column resistor chains, a new terminal configuration, terminal cryogenic pumping and various accelerator tube conditioning diagnostics. An analysis of voltage problems in MP tandems is presented, and the rationale for the relatively straightforward design changes that have been made is discussed. (auth)

26543 THE HEIDELBERG MP TANDEM VAN DE GRAAFF. Repnow, R.; Goldschmidt, M.; Haberkant, K.; Hildenbrand, K. D.; Hortig, G.; Jaeschke, E.; Martin, B.; Schule, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). Nucl. Instrum. Methods; 122: No. 1-2, 179-189(15 Nov 1974).

Properties and improvements of the Heidelberg MP tandem are reported. The upgrading to terminal voltages of 13 MV and the installation of new components are discussed in detail. The performance of the machine and projects in the future such as the installation of a pelletron charging device and a nanosecond beam pulsing system are described. (auth)

26544 THE MUNICH MP TANDEM. Assmann, W.; de Boer, J.; Meyer-Berkhout, U.; Skorka, S. (Muenchen Univ. (F. R. Germany). Sektion Physik); Huenges, E.; Kienle, P.; Morinaga, H.; Nolte, E.; Vonach, H. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.); Muenzer, H. Nucl. Instrum. Methods; 122: No. 1-2, 191-203(15 Nov 1974).

This paper describes some of the unique features of the Munich MP tandem facility. The improved voltage stabilizing system using the liner-terminal capacity and a time-of-flight system for absolute calibration and monitoring of the tandem beam energy with an absolute accuracy of 1.5×10^{-5} are discussed. Results of their performances are presented. The improved voltage stabilizing system has been tested by means of the time-of-flight system. The residual ripple at the terminal was measured to be less than 260 V fwhm. The time-of-flight system allowed the establishment of an accurate calibration energy in the tandem range by measuring the first $T = 3/2$ resonance in $^{12}C(p,p)^{12}C$ to be (14230.75 ± 0.2) keV. The Munich MP tandem conversion and upgrading program, initiated in 1973, is discussed in some detail. It includes installation of NEC-components into the MP tandem accelerator. Finally plans are presented to add a small energy booster to the MP tandem in order to increase the energy of the heavy ion beams presently available in the laboratory. It is designed to allow, typically, post-acceleration of Ni-ions from about 100 MeV to 200 MeV. (auth)

26545 THE BROOKHAVEN NATIONAL LABORATORY THREE-STAGE MP TANDEM VAN DE GRAAFF FACILITY. Thieberger, P.; Wegner, H. E. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Instrum. Methods; 122: No. 1-2, 205-212(15 Nov 1974).

The Brookhaven National Laboratory three-stage MP Tandem facility has been in operation for over four years since its construction completion. A number of modifications and improvements have been made in the accelerator system to extend its capabilities beyond the original design. These improvements and the current performance capabilities for two- and three-stage operation are discussed. (auth)

26546 THE NUCLEAR STRUCTURE FACILITY AT THE UNIVERSITY OF SAO PAULO. Sala, O.; Spalek, G. (Sao Paulo Univ. (Brazil). Instituto de Fisica). Nucl. Instrum. Methods; 122: No. 1-2, 213-225(15 Nov 1974).

The nuclear structure facility at the University of Sao Paulo is described. Some of the problems that have arisen with the pelletron accelerators are discussed, and a summary of operational experience with these accelerators is given. The performance of the 8UD accelerator is described in more detail with particular attention to the acceleration tube behavior. (auth)

26547 THE DEVELOPMENT OF ELECTROSTATIC ACCELERATORS. Bromley, D. A. (Yale Univ., New Haven, Conn. (USA)). Nucl. Instrum. Methods; 122: No. 1-2, 1-34(15 Nov 1974).

A brief history of the development of electrostatic accelerators, from 1926 to the present, is given; a number of historic photo-

graphs of the early accelerators have been included. The development of charge-changing acceleration has been traced from the pioneering work of Dempster at Chicago and of Gerthsen at Geissen. An attempt has been made to follow the development of the major technical innovations which have made feasible the present generation of large electrostatic accelerators. (auth)

26548 CONSTRUCTION OF A WIEN FILTER HEAVY ION ACCELERATOR. Jensen, K.; Veje, E. (Copenhagen Univ. (Denmark). H. C. Oersted Inst.). Nucl. Instrum. Methods; 122: No. 3, 511-515(15 Dec 1974).

A heavy ion accelerator (10 to 100 keV) with a Wien filter for mass analysis has been constructed. The ion source, the acceleration tube and the focusing device are of conventional construction and therefore discussed briefly, whereas the design of the Wien filter is discussed in more detail. (auth)

26549 VACUUM REQUIREMENTS FOR NEGATIVE ION TRANSMISSION IN TANDEM VAN DE GRAAFF ACCELERATORS. Wegner, H. E.; Thieberger, P. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Instrum. Methods; 122: No. 3, 287-289(15 Dec 1974).

The attenuation of heavy negative ions OH^-, Br^-, and I^- at 4, 6, and 8 MeV in O_2 and $C_{10}H_{22}O$ was measured using the unique capability of the three-stage MP Van de Graaff Facility at Brookhaven National Laboratory. The results are relevant to the new and larger tandem accelerators presently under design and construction. If average residual gas pressures can be maintained at 10^{-7} torr, negative ion losses due to gas stripping will be less than 1%. (auth)

26550 OPERATION RESULTS OF THE DYNAMITRON TANDEM AT BOCHUM. Blanke, E.; Brand, K.; Genz, H.; Richter, A.; Schrieder, G. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik). Nucl. Instrum. Methods; 122: No. 3, 295-302(15 Dec 1974).

The performance of the Dynamitron-Tandem accelerator at Bochum with respect to beam energy resolution stability and reproducibility, and beam intensity is reported. The energy resolution has been determined by measuring with thin targets (i) the shape of the neutron threshold in ^{7}Li(p,n) at E_p = 1.88 MeV and the width of a single isolated resonance in the reaction ^{28}Si(p,pl) at E_p = 5.197 MeV, (ii) the fine structure distribution of the lowest $\frac{1}{2}^+$ isobaric analogue resonance in the reaction ^{92}Mo(p,p_0) near E_p = 5.3 MeV, and (iii) the mean level width of the fluctuating excitation function near the lowest $\frac{1}{2}^+$ isobaric analogue resonance in the reaction ^{88}Sr(p,p_0) near E_p = 6 MeV. These measurements yield $\Delta E < 1.2$ keV at E_p = 1.88 MeV and $\Delta E = (1.5 \pm 0.2)$ keV at $E_p < 5.2$ MeV. The beam energy stability obtained from the resonance yield of ^{28}Si(p,pl) at 5.2 MeV was better than 120 eV and the absolute beam energy is reproducible to better than 3×10^{-4}. Energy analyzed maximum beam currents so far are 125 μA for protons at 8 MeV and 27 μA for $^{16}O(4^+)$ at 20 MeV. Operational experience of the tandem and its associated parts (high voltage generator, injector, beam handling system) over a period of about nine months has demonstrated the high reliability of the whole system. A major advantage compared to most accelerators is the extremely easy way to operate the machine. (auth)

26551 SPECTROSCOPY OF AEROSOLS FORMING AROUND THE SYNCHROCYCLOTRON OF THE LENINGRAD INSTITUTE OF NUCLEAR PHYSICS, ACADEMY OF SCIENCE, USSR. Aleksandrov, A. A.; Mironov, Yu. T. pp 67-72 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (Ed.). Moscow; Atomizdat (1974). (In Russian).

The formation of active aerosols around the synchrocyclotron basically results from the activation of Ar contained in the air. The concentration of aerosols in the synchrocyclotron hall does not exceed 5×10^{-12} Ci/l. The comparatively long-lived components ($T_{\frac{1}{2}} > 1$ hr) have a concentration of about 1.3×10^{-12} Ci/l and consist of several nuclides: ^{31}Si, ^{24}Na, ^{28}Mg, ^{32}P, ^{33}P, and ^{7}Be. (tr-auth)

26552 ANNUAL REPORT OF THE LAVAL UNIVERSITY VAN DE GRAAFF LABORATORY, 1974. Quebec; Laval Univ. (1974). 80p. (In French).

The activities of the Laval Univ. Van de Graaff Lab. are outlined for the period Dec. 1973 to Nov. 1974. The operating record of the accelerator was good and heavy ion acceleration was increasingly stressed. Additional software has increased the value of the PDP-9 computer for data acquisition and the PDP-15 for data analysis. Research programs in nuclear and solid-state physics are described. (CA)

26553 SUPERCONDUCTING CYCLOTRON. Bigham, C. B.; Schneider, H. R. (to Atomic Energy of Canada Ltd.). US Patent 3,868,522. 25 Feb 1975. Priority date 19 Jun 1973, Canada. 6p.

An isochronous cyclotron using an air core superconducting magnet to provide high intensity magnetic fields is described. To provide an axial focusing field, iron sectors are provided with spiral edges acting as flutter poles positioned in the magnetic field such that saturation of the iron in the sectors gives an increased field between the sectors and a slightly decreased field outside. (Official Gazette)

Auxiliaries and Components

26554 (BNL-50438) FIELD MATCHING IN PERIODIC IRIS-LOADED WAVEGUIDES: A NUMERICAL TREATMENT. Goldstein, C. (Brookhaven National Lab., Upton, N. Y. (USA)). Dec 1974. Contract AT(30-1)-16. 55p. Dep. NTIS $5.45.

Propagation of electromagnetic waves in periodic circular iris-loaded waveguides is investigated. The purpose is to determine an efficient numerical algorithm for calculating the dispersion relation for the lower passbands. Various equivalent mathematical formulations are developed and investigated numerically with regard to efficiency, accuracy and numerical stability. It is found that the most stable formulation is one that avoids the necessity of inverting matrices. Furthermore, this formulation allows the use of a different number of harmonics in the iris and the unperturbed waveguide, thus greatly improving the rate of convergence. Singular basis vectors are also employed. It is found, however, that no improvement in convergence results from this. (auth)

26555 (CNEA-367) BEAM TRANSPORT SYSTEM FOR THE BUENOS AIRES 28 MeV SYNCHROCYCLOTRON. Sametband, M. J.; Ferrero, A. M. J.; Ceballos, A. E.; Erramuspe, H. J.; Sofia, H. M.; Fazzini, N. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 43p. (In Spanish). Dep. NTIS (US Sales Only) $5.25.

The design and construction of the beam transport system of the 28-MeV synchrocyclotron of the Comisión Nacional de Energía Atómica is described. The trajectory of the extracted particles was calculated using the matrix method, choosing a focusing system formed by two quadrupole doublets and a deflecting magnet, whose purpose is to enable the use of two beams in the experimental area. The high vacuum system used in that area is described. (auth)

26556 (KIYI-73-9) CYCLOTRON EXTERNAL BEAM CONTROL SYSTEM. Bel'skii, E. M.; Galkin, E. A.; Gonopol'skii, Yu. A.; Kosinov, G. A.; Nemets, O. F.; Produvalov, Yu. S.; Usik, V. A. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1974. 12p. INIS.

A system for the control and correction of an accelerated ion beam at the 120-cm cyclotron was described. The realization of the operating control of the spatial location of the beam, of the current density distribution in its individual sections, and of the time characteristics of the beam during its transport to a specific target substantially increases the number and decreases the duration of experiments. (tr-auth)

26557 (ORNL-tr-2898) BIM EXPERIMENTS 43 AND 44. Krikorian, J. 1 Dec 1969. Translation by Martha Gerrard of SEDAP/69-324 SUP/89 NT. 8p. Dep. NTIS $4.00.

Results are presented on superconducting magnet studies at SATURNE. The excitation of the coil, pushed to the transition point, was undertaken in BIM-4-3. In experiment BIM-4-4, the behavior of the magnet was verified for a period of two days and the reliability of the whole BIM experiment was studied. (MCW)

26558 (ORNL-tr-2899) EFFECT OF COOLING CHANNEL SIZE ON OPERATION OF A SUPERCONDUCTOR COIL. Neel, J. 3 Jul 1968. Translated by Martha Gerrard from JN/GB SEDAP/68-126 SUP/04. 10p. Dep. NTIS $4.00.

In order to determine the optimum characteristics of the cooling channels of the BIM superconductor coil, which is 1 m dia, a systematic series of experiments was made and is continuing on a model. This model, or mock-up, is a small superconductor coil. From one experiment to the next, only the conditions for helium circulation or insulation of the band were changed. The electrical properties remained similar, the same superconductor band being rewound on the same drum for each experiment. (auth)

26559 HEAVY ION STRIPPING IN TANDEM ACCELERATOR TERMINALS. Yntema, J. L. (Argonne National Lab., Ill. (USA)). Nucl. Instrum. Methods; 122: No. 1-2, 45-52(15 Nov 1974).

The behavior of thin carbon film when bombarded by heavy ions ($Z > 16$) is discussed. A summary of useful formulae for estimating the average equilibrium charge states for heavy ions in both gas and carbon foil strippers is given together with a semi-empirical

formula to estimate the charge-state distributions. A summary of the present status of multiple scattering calculations and energy straggling measurements in solid strippers is given. (auth)

26560 RF LOSSES AND PEAK FIELDS IN HELICAL RESONATORS. Polchinski, J. G.; Jancaitis, K. S.; Tombrello, T. A. (California Inst. of Tech., Pasadena). Particle Accel.; 6: No. 1, 57-61(Feb 1974).

To provide reliable estimates of the peak fields and rf losses in a helically loaded resonator, the basic electromagnetic fields in the cavity are first obtained with a modified sheath model. Using a quasi-static, two-dimensional analysis and a conformal transformation, the enhanced fields on the helix wire are calculated. The present calculations are an improvement on an earlier paper (Laslett, Jancaitis and Tombrello, IEEE Trans. Nucl. Sci.; NS 20, No. 3: 188 (1973)), in that a mapping which more accurately represents the shape of the helix wires is used. The results of these calculations are compared with the experimental data of Bendt, Erkkila and Stokes (IEEE Trans. Nucl. Sci.; NS-20, No. 3: 185 (1973) and private communications). It is found that the cooling efficiency may be improved appreciably by using wire with a noncircular cross section. (auth)

26561 A MULTIPLE HALL PROBE UNIT FOR MAGNETIC FIELD MEASUREMENTS. Stewart, J. D.; Ophel, T. R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Nucl. Instrum. Methods; 123: No. 1, 193-194(1 Jan 1975).

Typical accelerator operation involves the use of numerous magnetic elements in the beam transport system. An inexpensive Hall probe device for magnetic field measurements on beam transport systems is described. (auth)

26562 IMPROVED BELT-CHARGING SYSTEM FOR BETTER TERMINAL STABILITY IN ELECTROSTATIC ACCELERATORS. Thieberger, P.; Lindgren, R.; McKeown, M.; Wegner, H. E. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Instrum. Methods; 122: No. 3, 527-531(15 Dec 1974).

The terminal voltage stability in a Tandem Van de Graaff accelerator can be substantially improved by using a simple constant-current supply to regulate the total charge flow from the belt to the high voltage terminal. Results obtained with such systems are described and the desirability of equalizing the charge densities on the up-run and the down-run of the belt is discussed. (auth)

26563 USE OF DUAL FOIL STRIPPING AT THE BROOKHAVEN TANDEM ACCELERATOR FACILITY FOR IMPROVED HEAVY-ION PERFORMANCE. Thieberger, P.; Wegner, H. E.; McKeown, M.; Manni, M.; Feigenbaum, I. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Instrum. Methods; 122: No. 3, 291-293(15 Dec 1974).

It is shown that the use of a dual foil-stripper system in a model MP tandem Van de Graaff accelerator is practical for routine operation and that significant improvements in high-energy heavy-ion performance are obtained in two-stage as well as in three-stage configurations. (auth)

26564 MULTIPLE-SECTION LINEAR ELECTRON ACCELERATOR WITH SYNCHRONIZED OSCILLATORS. Vikulov, V.F.; Volodin, V.A.; Milovanov, O.S. Sov. Phys.-Tech. Phys. 19: No. 7, 930-931 (Jan 1975).

The control and frequency characteristics of multisection linear electron accelerators supplied with rf power from synchronized oscillations are found as functions of the parameters of the synchronous, regime for the particular case of a two-section 10-MeV accelerator driven by two synchronized magnetrons. The calculated and experimental characteristics are compared. (auth)

26565 CIRCUIT FOR CONTROLLING A STREAK CAMERA. Medvedev, A. F.; Nikitin, M. M. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1087-1089 (1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 126-127(1974).

The remote control circuit for streak photography of the dynamics of an electron beam in a synchrotron based on the synchrotron radiation is described. The circuit is implemented using semiconductor elements, is reliable in operation, and ensures automatic locking of the streak photography to the particle-acceleration cycle. (auth)

26566 MEASUREMENT AND THE INTEGRATION OF PARTICLE ACCELERATORS BEAM CURRENTS. Popescu, D. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 6, 681-687(1974). (In Rumanian).

A classification for the measurement methods of particle accelerator beam current is given. The measurement systems are described pointing out the advantages and disadvantages of different methods. The secondary effects are discussed and conclusions are drawn concerning the use of particular methods. (auth)

Ion Sources and Injection and Extraction Systems

26567 (JINR-E9-8443) EXPERIMENTAL RESEARCH OF THE CLOSED ORBIT EXPANSION EFFECT IN THE STRONG FOCUSING CYCLOTRON. Vasilenko, A. T.; Glazov, A. A.; Dzhelepov, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

The theoretical and experimental study of beam extraction method using the closed orbit expansion effect is described. The steep slope of the magnetic field variation magnitude is used to change the momentum compaction factor into the limit radial area. The orbit separation is found by computing the dynamical equations, since the behaviour of the betatron oscillation frequencies and the beam phase are investigated in this radial region. The experimental study of the effect is carried out with the ring cyclotron electron model, which is a strong focusing eight sector isochronous cyclotron. Calculated orbit separation in the extraction area is about 2÷4 cm. The magnet system which is to obtain the proper gradient of the magnetic field variation and the magnet measurement results are described. The measured value of the orbit separation equals 4 cm. At the same time, the space between two orbits without current (free of particles) is about 2 cm and the full current on the separated orbit is equal to that before separation. The theoretically predicted beam phase shift is found to be equal to 30 to 40°. The obtained results confirm the possibility of the 100% beam extraction from the accelerator with space magnetic field variation. (auth)

26568 (NP-20324) CALCULATION OF THE FIRST SLOW EXTRACTION SEPTUM-MAGNET OF EREVAN ACCELERATOR. Suvorov, M. M.; Sudarushkin, A. S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1974. 23p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The first element of the slow beam extraction system from the accelerator is a magnet with a thin knife-type septum. High current density and considerable radiation heat evolution in the septum together with other features of the magnet require a high accuracy of calculation. The calculation of the first slow extraction-septum magnet of the Erevan accelerator is given. (auth)

26569 (TID-26730) BOOSTER II EXTRACTION KICKER DESIGN. Suddeth, D. E. (Argonne National Lab., Ill. (USA)). 16 Jan 1975. 8p. Dep. NTIS $4.00.

Operating parameters of the kicker magnet extraction system for the 5-GeV ZGS Booster Synchrotron II are given. (WHK)

26570 A SURVEY OF NEGATIVE ION SOURCES FOR TANDEM ACCELERATORS. Middleton, R.; (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Nucl. Instrum. Methods; 122: No. 1-2, 35-43(15 Nov 1974).

Briefly reviewed are the most commonly employed methods of making negative ions and the ion sources that are presently available and most suitable for use with tandem accelerators. Particular emphasis is placed on recent developments such as the production of negative ions by cesium beam sputtering and by direct extraction from a Penning source using a cesium seeded arc. Some suggestions for possible future development are made. (auth)

26571 EFFECT OF ENERGY SPECTRUM OF ELECTRONS ON THEIR CAPTURE DURING ACCELERATION IN A BETATRON. Evstigneev, V. V.; Milyutin, G. V. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 24-29(1974). (In Russian).

The energy spread of electrons has a stabilizing effect on the movement of the beam in all stages of the acceleration cycle. The possibility of the capture of electrons with different energy values by the azimuthal-symmetric magnetic field is examined. It was shown that during injection, electrons with given values of the pulse momentum component of the system M_z, at which the spread $\Delta C \neq 0$ can be captured. On the basis of the picture obtained of electron capture the maximum possible relative energy spread of electrons captured during external injection was evaluated as 17.4% and the relative energy spread of zero (with $C = 0$) electrons was evaluated as 1.12%. The region of finite movement of the electrons which should be included in the cross section of the vacuum chamber in order to obtain the maximum accelerated charge was determined. (tr-auth)

26572 ON THE PROBLEM OF THE CALCULATION OF TWO-DIMENSIONAL ELECTROSTATIC FIELDS. Dmitrievsky, V. P.; Kolga, V. V.; Trejbal, Z. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Instrum. Methods; 123: No. 1, 189-192 (1 Jan 1975).

The method for calculating two-dimensional electrostatic fields with respect to the beam extraction systems of cyclic accelerators is considered. (auth)

26573 PIG ION SOURCE WITH END EXTRACTION FOR MULTIPLY CHARGED IONS. Baumann, H.; Bethge, K. (Heidelberg Univ. (F. R. Germany). 2. Physikalisches Inst.). Nucl. Instrum. Methods; 122: No. 3, 517-525(15 Dec 1974).

A PIG discharge ion source with end extraction of the ions has been developed for a continuous operation of the discharge with voltages up to 6 kV. The axial magnetic field is produced by a solenoid. The total extracted beam current was thoroughly investigated concerning its dependence on the source parameters which yielded data on the optimal operating conditions. Depending on ion mass total beam currents between 1 and 4 mA have been extracted with an average power consumption (without magnetic field) of about 20 W/mA. The fractions of multiply-charged ions of the ion beam have been measured for a source operation with noble gases and several gaseous compounds. A comparison with cross sections for the ionization of neutral atoms by single electron impact suggests that this process is dominant in producing the multiply-charged ions. (auth)

26574 PRESSURE-YIELD CHARACTERISTICS OF RF ION-SOURCES. Misra, S. N.; Gupta, S. K. (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.). Nucl. Instrum. Methods; 122: No. 3, 303-306(15 Dec 1974).

A system which analyses the components of the charged particle beam current just after the rf ion-source has been used to measure the yields of the components as a function of the pressure at which the gas is fed into the ion-source. The yield of an HH^+ beam is more than that of an H^+ beam at a lower hydrogen gas feed and the situation reverses at higher gas feed. With ^3He the fraction of $^3H^{++}$ beam is obtained to be only ~0.4% under optimum conditions. A qualitative explanation for the behavior of ion-beam both with hydrogen and helium gases has been suggested. (auth)

Ion Optics and Field Calculations

26575 (AD-785253) STUDY OF ELECTRON BEAM PROPAGATION EFFICIENCIES IN NEUTRAL GAS AS A FUNCTION OF *vy*. Final Report, 1 June 1970-30 June 1971. Cooperstein, G. (Ion Physics Corp., Burlington, Mass. (USA)). 30 Jun 1972. DASA01-70-C-0161. 89p. (DNA-3017F). NTIS $7.50.

The propagation efficiency of pulsed relativistic electron beams of approximately 225 keV mean electron kinetic energy with currents ranging from 30 to 88 kiloamps has been studied as a function of drift tube length (5 to 300 centimeters) and drift tube pressure (.1 to 2 torr). All the data were taken with air as the transport medium and with no preionization and no externally applied magnetic fields. Simultaneous measurements were made of the diode voltage and current, the beam currents at both the entrance and exit of the drift tube, and the total beam energy and primary beam current at the exit of the drift tube. A complete description of all the experimental apparatus is given. (GRA)

26576 (NP-20325) BENDING ELECTROMAGNET POLE. Suvorov, M. M. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 10p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The electromagnet poles have a tendency to local material saturation in the angle region. This effect changes the space field distribution in the electromagnet gap and deteriorates the field homogeneity with induction increase. The side surface poles of a special form where this phenomenon is absent are considered. (auth)

26577 (NP-20337) ERRORS OF THE DISCRETE-CONTINUOUS METHOD OF CALCULATION FOR CHARGED PARTICLE INTENSE BEAMS. Trubnikov, G. I. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The general properties of the numerical method of four-dimensional transient calculation for the beams devoid of rotation symmetry are given. The errors of this particular and similar methods are investigated in detail. (auth)

26578 NEW DEVELOPMENTS IN BEAM TRANSPORT THROUGH TANDEM ACCELERATORS. Larson, J. D. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Instrum. Methods; 122: No. 1-2, 53-63(15 Nov 1974).

Beam transport through tandem electrostatic accelerators is described with emphasis on frequently encountered transmission problems. New developments in inclined-field acceleration tubes and high-transmission beam optics are presented. A novel use of quadrupole lenses as dispersive elements is proposed as a possible charge selection mechanism for use in the high-voltage terminal. Matrix formulations are given for beam transport through inclined-field tubes and gas and foil beam strippers. (auth)

26579 INSTALLATION FOR STUDYING THE TOPOGRAPHY OF THE FIELD OF MAGNETIC ELECTRON LENS. Zhernovoi, A. I.; Sochneva, E. G. pp 183-185 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (Ed.). Moscow; Atomizdat (1974). (In Russian).

An installation was constructed for studying the topography of the field of electron optics focusing systems. It consists of a polarizer, a detector for counting the NMR signals, a block of sensing elements for measurement of the field of lens with transverse field, and a block of sensing elements for measuring the field of lens with longitudinal field. (JSR)

26580 PHASE MOTION OF PARTICLES IN AN ACCELERATOR WITH AN AZIMUTHALLY VARYING ELECTRIC FIELD. Voroguskin, M.F.; Petrunin, V.I. Sov. Phys.-Tech. Phys. 19: No. 7, 926-929 (Jan 1975).

The slow phase motion of particles in an accelerator with an azimuthally varying electric field is analyzed by averaging the dynamic equations. Phase focusing is caused by the rf field components. (auth)

26581 CONTROL OF OUTPUT ENERGY IN LINEAR ELECTRON ACCELERATORS. Golovin, V.N.; Sobenin, N.P. (Submitted September 27, 1972; resubmitted October 1, 1973)). Sov. Phys.-Tech. Phys. 19: No. 7, 932-934 (Jan 1975).

A method of control of beam output energy in a linear electron accelerator is described. The method lies in injecting bunches of small phase width (~60-90°) whose phase relative to the high-frequency wave is determined by a phase shifter; these are injected into a waveguide buncher with an equilibrium phase of $\pi/2$. With this method the beam output energy can be controlled up to energies approaching the rest energy. The mean beam output energy and the energy spread are determined. Possible implementation schemes are suggested. (auth)

26582 ANALYTICAL APPROXIMATIONS FOR THE FOCAL PROPERTIES OF THE PLANE-GRID AND CYLINDER ELECTROSTATIC LENS SYSTEM. Young, C. E. (Argonne National Lab., Ill.). Rev. Sci. Instrum.; 46: No. 3, 296-298(Mar 1975).

Analytical expressions are derived for the paraxial focal properties of the unsymmetrical lens system formed by adjacent planar-grid and cylindrical conductors. Resulting focal lengths and principal plane positions are shown to be in good agreement with existing ray-tracing calculations, especially in the converging lens region of voltage ratios $0.1 \leq V_2/V_1 \leq 1$. Modifications applicable in the strongly diverging lens region ($V_2/V_1 > 2$) are indicated. (auth)

Storage Rings

Refer also to abstract 25903.

26583 (BNL-19583) BEAM-BEAM RESONANCES IN HEAD-ON COLLISIONS OF ELECTRONS AND POSITRONS. Month, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 6 Jan 1975. 36p. Dep. NTIS $4.75.

Observations of electron-positron collisions demonstrate the existence of a limiting strength to the beam-beam force. The tune dependence of this beam-beam limit suggests the influence of nonlinear resonances. However, beam-beam resonances differ considerably from the normal multipole resonances induced by magnetic fields. In particular, the resonant widths from the beam-beam interaction have a rather slow variation with amplitude for large amplitudes, in marked contrast to the resonant widths caused by multipole fields, which rise with amplitudes with a power corresponding to the order of the nonlinear resonance. This peculiar resonance behavior of the beam-beam interaction has resulted in an inability to explain the tune dependence of the beam-beam limit in terms of conventional resonances. However, it is found here that a closer analysis of beam-beam resonances indicates that the lock-in process can indeed occur. This mechanism of particle trapping is exploited to arrive at a picture of beam-beam resonances, one which contains within it the basic ingredients permitting beam size growth and particle loss to external apertures. Results suggest that an isolated resonance mechanism may be the source of the observed beam-beam limit in electron-positron collisions. (auth)

26584 (BNL-19784) BEAM–BEAM RESONANCES EXCITED BY PROTON–PROTON COLLISIONS. Month, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 11 Feb 1975. 34p. Dep. NTIS $4.75.

Observations at the ISR on the beam-beam interaction of two coasting proton beams give clear evidence of non-linear resonance excitation. The two main features are: (1) the observation of odd-ordered resonances excited by small vertical orbit misalignments at the collision points; and (2) the strong dependence of the loss rate on the position of the physical aperture boundary. Although there is a hint of the 8th order resonance, the strongest effects are seen in the regions of a stack corresponding to the odd-ordered resonances, in particular the 5th and the 7th. To describe these observations, a theory of beam-beam resonances is proposed, one which takes proper account of their peculiar nature. The basic mechanism for beam growth and loss is the familiar lock-in process. Loss rates are estimated as a function of the magnitude of the misalignments and the distance of the physical aperture boundary. The theory of lock-in requires a time variation of tune. In a coasting beam, there is no obvious periodic modulation, such as is caused by synchrotron motion in a bunched beam. Scattering processes do however produce such a modulation. In particular, intrabeam scattering causes a momentum diffusion, which, via the machine chromaticity, induces a drifting tune. Particles lock-in, drift through the resonance and are transported to the aperture limit. In addition to tune drift, the diffusion process also provides a feeding mechanism whereby particles are fed into the resonance tune range and from there are channelled to the aperture boundary as their betatron amplitude grows. The results obtained here are in general agreement with ISR observations. Some extrapolations to future p-p machines are given. (auth)

26585 STORAGE RING LUMINOSITY MEASUREMENTS BY SMALL ANGLE e^+e^- SCATTERING. Barbiellini, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati); Ceradini, F.; Paoluzi, L.; Santonico, R. (Rome Univ. (Italy). Istituto di Fisica). Nucl. Instrum. Methods; 123: No. 1, 125-129(1 Jan 1975).

A counter system is presented, designed to measure the luminosity of Adone, the Frascati e^+e^- storage ring, by detecting electron-positron pairs scattered at small forward angles. Characteristics and performances of the apparatus are discussed on the basis of the results collected during several months of measurements at energies of 600 to 1500 MeV per beam. The results are found to be in agreement, within the quoted systematic errors, with those obtained by a single bremsstrahlung luminosity monitor. (auth)

Experimental Facilities

Refer also to abstracts 25942 and 25970.

26586 (CNEA-369) FACILITY FOR THE MEASUREMENT OF NEUTRON SPECTRA BY THE TIME-OF-FLIGHT METHOD. Abbate, M. J.; Remez, L. A.; Lolich, J. V.; Volkis, J. E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 23p. (In Spanish). Dep. NTIS (US Sales Only) $4.25.

An experimental facility was designed, constructed, and tested for accurate measurements of low-energy neutron spectra by the pulsed-source time-of-flight method, using the 30-MeV electron linear accelerator at Centro Atómico Bariloche (CAB). This time-of-flight facility will be an important tool in neutron and reactor physics studies. The principal steps involved in this project were: (1) the design and construction of a 17-m evacuated flight path, a collimation system and the necessary shielding; (2) the mounting, testing and optimization of a ^{6}Li neutron detector; (3) the specification, design, construction, and operation of associated electronics, including an "on-line" data acquisition and accumulation system, using the CAB computer; (4) the utilization of auxiliary techniques for flux mapping and time-dependent measurements; and (5) the development of a code system for data acquisition, reduction, and correction. Also the standard experimental techniques used in the implementation of the spectra study program are described. Results were obtained which agree very well with "well-known" spectra measurements. (auth)

26587 (CONF-730941-, pp 165-174) PRACTICAL CLINICAL CRITERIA FOR A FAST NEUTRON GENERATOR. Neurath, P. (Tufts–New England Medical Center, Boston). 1973.

From grantees conference on instrumentation technology; Washington, District of Columbia, USA (25 Sep 1973).

In proceedings of the grantees conference on instrumentation technology.

The specifications and prices of commercial neutron sources for radiotherapy are listed and discussed. (WHK)

26588 (LA-5833-MS) THIN WINDOWS FOR GASEOUS AND LIQUID TARGETS: AN OPTIMIZATION PROCEDURE. Hassenzahl, W. V.; Gray, W. H. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1974. Contract W-7405-eng-36. 17p. Dep. NTIS $4.00.

Many nuclear physics experiments require cryogenic or high-pressure gas targets with thin windows. To obtain the best data, i.e. to reduce background signals, a target window would ideally have zero thickness and zero deflection. Since this is not possible a trade off is made among target geometry, window geometry, window material, and window thickness. Measurements of deflections of a variety of window materials and geometries were performed at room temperature and in liquid nitrogen to aid in designing windows in the future. A simple graphical method for predicting the rupture pressure for several typical window materials is described. The results of the deflection measurement are compared to a finite element computer program MEMBRAN which predicts window deflection and material stresses for a uniform applied pressure. (auth)

26589 (SLAC-179(Vol.2), pp 139-157) STATUS REPORT ON OMEGA APPARATUS AND OMEGA EXPERIMENTS. Treille, D. (CERN, Geneva). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

This is a status report on Omega apparatus and Omega experiments. It includes some preliminary results and an attempt to point out what lessons can be learned from one year of running. (auth)

26590 (UCRL-51737) HYDROGEN ISOTOPE FLOW IN THE ROTATING-TARGET NEUTRON SOURCE. Nickerson, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1975. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

The degradation mechanisms of titanium tritide (TiT_2) neutron-source targets are not completely understood. Mass flow of the target tritium and the beam-implanted deuterium under rapidly pulsed heat fluxes of rotating targets have not been investigated. This report presents results of mass-flow calculations using the TRUMP heat-flow finite-difference computer code. The conclusion of this study is that the best compromise between long target life and high neutron output is achieved when targets are operated in the narrow range where the rate of evolution of hydrogen isotopes from the target just balances the rate of deposition of hydrogen isotopes from the beam. (auth)

26591 SYNCHROTRON AND ONDULATOR RADIATION OF THE PAKhRA ELECTRON ACCELERATOR OF FIAN. Alferov, D. F.; Bashmakov, Yu. A.; Belovintsev, K. A.; Bessanov, E. G.; Mikhailin, V. V.; Tamm, E. I.; Cherenkov, P. A. pp 39-42 of Trudy Tret'ego Vsesoyuznogo Soveshchaniya po Uskoritelyam Zarvazhennykh Chastits. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The basic characteristics are presented of the radiation of the FIAN 1.3-GeV electron synchrotron for studies on spectroscopy of solids, molecular physics, biology, photochemistry, and radiation chemistry. Two main optical channels are provided, arranged so that the radiation is released tangent to the orbit of the electrons through the vacuum light conductor. Spectral devices will be placed in the channels, e.g., monochromators for conducting experiments in the spectrum region from 1 to 2000 Å. (INIS)

26592 FIAN 680 MeV SYNCHROTRON AS A VACUUM ULTRAVIOLET RADIATION SOURCE. Moroz, E. M.; Petukhov, V. A.; Yakimenko, M. N. pp 31-33 of Trudy Tret'ego Vsesoyuznogo Soveshchaniya po Uskoritelyam Zaryazhennykh Chastits. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The results of calculations on the lifetime of the electron beam of the FIAN 680-MeV synchrotron are presented. The studies were made to determine the possibility of operating the synchrotron in a quasi-continuous regime in order to sharply increase the length of exposure of samples to the beam of vacuum ultraviolet radiation. It was noted that the beam intensity may also be increased by an additional reflecting mirror in the synchrotron chamber. The basic parameters and the spectral density of the beams of uv radiation from the FIAN synchrotron are compared with those of the DEZI (Federal Republic of Germany) and ARUS (Erevan) accelerators. (INIS)

26593 COMPUTER-AIDED CONTROL OF SEPARATED BUBBLE CHAMBER BEAMS. Lazeyras, P.; Lehraus, I.; Matthewson, R.; Tejessy, W. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 123: No. 1, 11-44(1 Jan 1975).

Hardware and software for an on-line system of controls of magnetic elements, collimators, rf separators, multiwire proportional chambers and scintillation detectors designed for tuning and monitoring of separated bubble chamber beams at CERN are described. The internal structure and organization of the system and some of its operational features are discussed in detail. (auth)

26594 TARGET TECHNIQUES FOR THE ISOLDE ON-LINE ISOTOPE SEPARATOR. Ravn, H. L.; Sundell, S.; Westgaard, L. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 123: No. 1, 131-144(1 Jan 1975).

New target and ion-source systems have been developed for an isotope separator on-line (ISOLDE-2) with the 600 MeV CERN synchrocyclotron. The system constitutes a further development of the molten-metal target for production of alkali elements by means of surface ionization. The design has been modified to permit the use of much larger proton-beam intensities than before, and the method has been extended to new regions of elements. The paper lists 27 elements, which either have already been separated or which are believed to be readily available with the techniques described here. Two different types of surface-ionization sources are used to produce alkali, alkaline-earth and rare-earth elements from molten-metal targets. A new series of target systems for noble-gas production is considered, where the molten metals are connected with a plasma ion source. An improved version of the molten Pb target has been developed, where higher yields of the short-lived Hg isotopes have been obtained by electromagnetic stirring of the target melt. Finally, the use of targets involving irradiation and/or transfer of chemical compound has been considered. Preliminary results from on-line separation of Po and At from molten $ThF_4 \cdot LiF$ are reported. (auth)

26595 DESIGN AND PERFORMANCE OF THE MULTIPARTICLE ARGO SPECTROMETER SYSTEM. Anderson, E. W.; Collins, G. B.; Fisher, G. P.; Lazarus, E.; Moy, K. M.; Ramanauskas, A.; Schuebelin, P.; Siemann, R.; Thorndike, A. M.; Turkot, F. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Instrum. Methods; 122: No. 3, 587-598(15 Dec 1974).

The Multiparticle Argo Spectrometer System, MASS, consists of a magnetic vertex spectrometer, two external trigger spectrometers, an on-line monitoring system and an off-line data analysis chain. The performance of MASS has been evaluated from physics data taken in a study of 28.5 GeV/c pp collisions covering a large range of transverse momentum. (auth)

26596 THE QMQ/2, A MAGNETIC SPECTROGRAPH FOR NUCLEAR RESEARCH. Drantje, A. G. (Rijksuniversiteit Groningen (Netherlands). Kernphysisch Versneller Instituut); Enge, H. A.; Kowalski, S. B. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Nucl. Instrum. Methods; 122: No. 3, 485-490(15 Dec 1974).

A new magnetic spectrograph, the QMG/2, has been designed as a beam analyzing system for the AVF cyclotron at the Kernfysisch Versneller Instituut, Groningen. It is similar to the Q3D spectrographs in use at several nuclear physics laboratories but includes some new features. Among these are a second multipole, a straight focal plane, constant dispersion, constant angle of incidence (45°) on the detector, and a device called a "snake" used to adjust mechanically the effective shape of the field boundaries after manufacture. (auth)

26597 THE ON-LINE SATELLITE/CENTRAL COMPUTER FACILITY OF THE MULTIPARTICLE ARGO SPECTROMETER SYSTEM. Anderson, E. W.; Fischer, G. P.; Hien, N. C.; Larson, G. P.; Thorndike, A. M.; Turkot, F.; von Lindern, L. (Brookhaven National Lab., Upton, N. Y. (USA)); Clifford, T. S.; Ficenec, J. R.; Trower, W. P. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Nucl. Instrum. Methods; 122: No. 3, 479-484 (15 Dec 1974).

An on-line satellite/central computer facility has been developed at Brookhaven National Laboratory as part of the multiparticle Argo Spectrometer System (MASS). This facility, consisting of a PDP-9 and a CDC-6600, has been successfully used in a study of proton-proton interactions at 28.5 GeV/c. (auth)

26598 A CAMAC DATA COLLECTION FACILITY. Davies, M. P. H.; Haddon, S.; Hagan, P. J.; Hunt, R. A.; Macefield, B. E. F.; Wilkinson, C. A. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Instrum. Methods; 122: No. 3, 451-461(15 Dec 1974).

An on-line data collection facility for the Nuclear Structure Facility at Oxford has been developed based on a multi-user PDP10/PDP7 computer system. A data collection system based on the PDP7 has existed for some time and the facility described provides a second on-line station based on the PDP10. This development has been based on the CAMAC instrumentation standard. Designing the system in CAMAC has allowed the construction of computer independent data collection hardware. (auth)

26599 ON-LINE DETERMINATION OF TRANSPORT TIME OF A HELIUM-JET SYSTEM. Macias, E. S.; Head, R. E.; Hseuh, H. C.; Zalutsky, M. R. (Washington Univ., St. Louis, Mo. (USA). Dept. of Chemistry). Nucl. Instrum. Methods; 122: No. 3, 365-368(15 Dec 1974).

A rapid accurate method for determining the recoil transport time of a helium-jet system by measuring the output activity ratio of two nuclides produced in a single charged particle bombardment with known cross-section is given. The minimum transport time of the Washington University helium-jet system, (149 ± 29) ms, was determined using this method with the 0.21 and 78 s isomeric states of ^{109}In. For a 25 MeV alpha-particle bombardment of natural silver the ^{109}In cross-section ratio was found to be $\sigma_{0.21s}/\sigma_{78s} = 0.41 \pm 0.04$. (auth)

26600 EFFICIENCY OF INTERNAL TARGETS IN THE ACCELERATOR AT THE INSTITUTE OF HIGH-ENERGY PHYSICS. Gridasov, V.I.; Myznikov, K.P.; Chepegin, V.N. Sov. Phys.-Tech. Phys. 19: No. 7, 922-925 (Jan 1975).

The accelerator at the Institute of High-Energy Physics has been studied in an attempt to maximize the efficiency of the beam-target interaction. An efficiency higher than 90% can be achieved if the beam is brought onto the target slowly; an efficiency of 30%-50% can still be achieved if the beam is brought onto the target rapidly, in a time as short as 1 msec. (auth)

26601 A HIGH-VOLTAGE CONNECTING DEVICE FOR NEUTRON GENERATORS. (to Texaco Development Corp., New York (USA)). French Patent 2179527/A/. 11 Apr 1972. 12p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A high voltage connector for a nuclear diagraphy probe is described. The connector consists of a conductor placed axially in the interior of a teflon-molded insulator. This insulator has one smooth transverse surface which serves as the end wall of the probe containing the gas under high pressure. (tr-FR)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 25803, 25906, 26721, 26807, 27184, 27208, and 27306.

26602 OBSERVATION AND EXPLANATION OF A 0.3% SUNWARD RADIAL STREAMING OF 1 TO 5 GV COSMIC RADIATION. Dyer, C. S.; Engel, A. R.; Quenby, J. J.; Webb, S. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). Solar Phys.; 39: No. 1, 243-259(Nov 1974).

Quiet-time anisotropy data have been obtained by the HEOS-1 spacecraft between December 1968 and April 1970 using an 8-sector analysis of a Cherenkov telescope which has a threshold rigidity of about 1 GV for protons. Meridian and ecliptic plane scans were made. Data obtained at satellite altitudes greater than 20 Earth radii were selected and showed consistent evidence for a sunward radial streaming component of amplitude ~0.3% while the azimuthal component from the east showed an apparently significant variation from 0.6% at the start of the period to less than 0.2% at later times. Experimental effects are considered and eliminated as a spurious source of the anisotropy. As there is no comparable radial streaming at neutron monitor rigidities this effect would appear to be largely confined to particles in the rigidity range 1 to 5 GC. Radial streaming of this amplitude is incompatible with the Urch–Gleeson numerical solutions of the Fokker–Planck transport equation under spherical symmetry. Also no significant correlation of the anisotropy with the interplanetary sector structure was found. A probable explanation lies in a symmetrical falling off-ecliptic gradient associated with the zones of maximum solar activity. (auth)

26603 INSTALLATION DESIGNED FOR THE INVESTIGATION OF THE PROPERTIES OF SUPER-HIGH-ENERGY MUONS. Aglamazov, V. A.; Gedevanishvili, L. D.; Gokieli, V. D.; Petrosyan, Zh. S.; Robakidze, Z. P.; Sakvarelidze, I. I.; Khazaradze, N. G. (Tbilisi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 76: No. 3, 597-600(Dec 1974). (In Russian).

Investigation of muons of the energy $\geq 10^{12}$ eV is extremely interesting due to the possible occurrence of nontrivial generation processes of high energy muons (1,2). An installation enabling the study of the muon energy spectrum for various zenith angles and nuclear interaction of muons with the energy $E \geq 10^{12}$ eV was developed at the Cosmic Rays Laboratory of the Tbilisi State University. (auth)

26604 GALACTIC POSITRONS AND γ-RAYS, AND THE COSMIC-RAY MEAN PATH-LENGTH IN THE GALAXY. Dilworth, C. (Cambridge Univ. (UK). Inst. of Theoretical Astronomy); Maraschi, L.; Perola, G. C. (Milan Univ. (Italy). Instituto di Scienze Fisiche; Consiglio Nazionale delle Ricerche, Milan (Italy). Lab. di Fisica Cosmica e Tecnologie Relative). Astron. Astrophys.; 33: No. 1, 43-48(Jun 1974).

1 fig.; 21 refs.

The interstellar equilibrium spectrum of cosmic-ray positrons arising from meson decay is calculated with two propagation models [a) slow leakage from the galactic disk, and b) isotropic diffusion] using the information on cosmic ray distribution in the Galaxy obtained from an analysis of the γ-ray data. Comparison with the experimental information on the interstellar positron flux suggests that in model a) the mean path length should be energy or rigidity dependent with a value of 2 g/cm^2 at 1 GeV (for positrons). In the model of isotropic diffusion out to distances of the order of the galactic radius, no dependence of the mean path length on energy is required from the positron data. The results are discussed in relation with those obtained from the data on the fragmentation of the nucleonic component. (auth)

26605 OBSERVATION OF THE DIFFUSE COMPONENT OF COSMIC SOFT X-RAYS. Hayakawa, S.; Kato, T.; Tanaka, Y.; Yamashita, K. (Department of Physics, Nagoya University, Nagoya, Japan); Bleeker, J.A.M.; Deerenberg, A.J.M. Astrophys. J. 195: No. 2, 535-543 (15 Jan 1975).

A soft X–ray survey by means of thin–window proportional counters on board a spinning rocket covered a large celestial region with a width of about 60° in galactic latitude. In the galactic anticenter side the distribution of the soft X–ray intensity is rather smooth and shows a gradual increase with galactic latitude, whereas in the galactic center side the distribution is irregular and shows several enhanced regions. The overall distribution and the energy spectrum are accounted for in terms of a superposition of the following three components: an extragalactic hard component with a power–law spectrum as established at energies higher than 2 keV, a galactic soft component which has an exponential spectrum with an apparent temperature of 0.18 ± 0.02 keV, and an extragalactic component with a similar exponential spectrum. (auth)

26606 GALACTIC POSITRONS AND γ-RAYS, AND THE COSMIC-RAY MEAN PATH-LENGTH IN THE GALAXY. Dilworth, C. (Inst. of Astronomy, Cambridge, Eng.); Maraschi, L.; Perola, G. C. Astron. Astrophys.; 33: No. 1, 43-48(Jun 1974).

The interstellar equilibrium spectrum of cosmic-ray positrons arising from meson decay is calculated with two propagation models [(a) slow leakage from the galactic disk, and (b) isotropic diffusion] and using the information on cosmic-ray distribution in the Galaxy obtained from an analysis of the γ-ray data. Comparison with the experimental information on the interstellar positron flux suggests that, in model (a), the mean path length should be energy or rigidity dependent with a value of 2 g/cm^2 at 1 GeV (for positrons). In the model of isotropic diffusion out to distances of the order of the galactic radius no dependence of the mean path length on energy is required from the positron data. The results are discussed in relation with those obtained from the data on the fragmentation of the nucleonic component. (auth)

26607 POSSIBLE EXPLANATIONS OF THE "HIGH" NUMBER OF COUNTS IN THE SOLAR NEUTRINO EXPERIMENT. Pallister, W. S.; Wolfendale, A. W. (Univ. of Durham, Eng.). Nature (London); 251: No. 5475, 488-489(11 Oct 1974).

Reference is made to the data presented by Evans and others on the rate of production of ^{37}Ar with the Brookhaven Solar Neutrino Detector (see Nature 251: 486 (1974) and various conferences). In these data the overall mean rate is lower than expected, but in one run the rate may be significantly higher than in the remainder. The present note is concerned primarily with the statistical significance and explanation of this high rate. It appears that this rate was in reality anomalously high, but more data accumulated over the next year or so should enable a more definite conclusion to be arrived at. If the data are anomalously high this may be due to the following possibilities: (i) the presence of an unusual non-Poissonian increase in background; (ii) the effect of a large solar flare; or (iii) the arrival of neutrinos from a cosmic source. Each of these possibilities is examined and (iii) is considered the most likely, and associated with collapsing stars. (UK)

26608 BROOKHAVEN SOLAR NEUTRINO DETECTOR AND COLLAPSING STARS. Evans, J. C. (Brookhaven National Lab., Upton, NY); Davis, R. Jr.; Bahcall, J. N. Nature (London); 251: No. 5475, 486-488(11 Oct 1974).

A description is given of the Brookhaven solar neutrino detector which has been in continuous operation since 1970. The basis of the detection method is the inverse β decay of ^{37}Cl to produce ^{37}Ar which can be detected at a sensitivity level of 10 to 20 atoms, using C_2Cl_4 as working fluid. On January 4, 1974 a possible collapsing star event was observed by the University of Pennsylvania water Cherenkov antineutrino detector, and the Brookhaven C_2Cl_4 tank was swept as soon as possible after this event with a view to detecting any associated neutrino pulse. The result was negative. This failure to observe neutrinos associated with the event is a serious constraint on possible interpretations in terms of collapsing stars. Under most astrophysical circumstances equal numbers of neutrinos and antineutrinos would be expected, whereas the observations imply an antineutrino flux more than four times the upper limit on the neutrino flux. It is finally concluded that the absence of detectable neutrinos is puzzling if the event of January 4th was caused by antineutrinos from a collapsing star. (UK)

26609 POSSIBLE ANTINEUTRINO PULSE OF EXTRATERRESTRIAL ORIGIN. Lande, K. (Univ. of Pennsylvania, Philadelphia); Bozoki, G.; Frati, W.; Lee, C. K.; Fenyves, E.; Saavedra, O. Nature (London); 251: No. 5475, 485-486(11 Oct 1974).

An unusual event is reported that was observed in Jan. 1974 during a search for electron antineutrino bursts of extraterrestrial origin, using a deep underground burst detector at the Brookhaven Solar Neutrino Observatory. Water Cherenkov counters were employed, designed to detect burst interactions with positrons resulting from $\bar{\nu}_e + p \rightarrow n + e^+$. Details are given of the counters and of the ancillary equipment and its mode of operation. The energy associated with the observed pulses was estimated as $20\ \text{MeV} \leq E \leq 100\ \text{MeV}$, and the pulse duration period was < 0.8 sec. The time distribution of the bursts and the pulse distribution within each burst are shown graphically, and details of the burst data are shown tabulated. About 7.5 vertical muons per day were observed traversing each detector together with a large angle muon passing through two detectors about once in two days. From

these numbers it is predicted that about one muon traversed all the detectors once a year. Speculations are offered on possible sources of the antineutrinos, including the gravitational collapse of stars. (UK)

26610 OBSERVATION OF COSMIC γ RAYS WITH $E_\gamma > 100$ MeV FROM THE CENTRAL PART OF THE GALAXY. Belyaevskii, A. I.; Bokov, V. L.; Vocharkin, V. K.; Bugakov, I. F.; Derevitskii, Yu. G.; Gorodinskii, G. M.; Kruglov, E. M.; Pyatigorskii, G. A.; Chuikin, E. I. (Ioffe Inst. of Physics and Tech., Leningrad). Dokl. Akad. Nauk SSSR; 219: No. 4, 836-839(1 Dec 1974). (In Russian).

On the basis of data from a γ telescope provided with supplementary counters on board the Cosmos-561, an attempt was made to measure γ quanta with $E_\gamma > 100$ MeV from the center of the Galaxy. The method used for the comparison of data from two regions of the celestial sphere was described in detail. The region which included the central part of the Galaxy gave a higher counting rate than the other regions. The γ flux was evaluated as $(8.3 \pm 2.7) \times 10^{-5}$ quanta/(sec·cm^2). (JSR)

26611 CHARGE SPECTRUM OF HEAVY COSMIC RAY NUCLEI MEASURED IN THE BIOSTACK EXPERIMENT ABOARD APOLLO 16 USING PLASTIC DETECTORS. Enge, W.; Beaujean, R.; Bartholomae, K. P.; Fukui, K. (Institut fuer Reine und Angewandte Kernphysik, Kiel). pp 51-56 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on life sciences and space research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

In the Biostack experiment flown aboard Apollo 16 plastic detectors were used to select those individual biological objects which were hit by single heavy cosmic-ray nuclei during the 266 hours of space flight. The energy loss deposited in the biological object can be determined. This method needs a separate calibration in every experiment, i.e. an individual track etching rate as function of the energy loss. This calibration is given. An area of 36 cm^2 of eight cellulose nitrate sheets was scanned for tracks of heavy cosmic-ray particles that stopped in the sheets. About 200 particles could be evaluated. Calibration was achieved using the oxygen isotope ^{16}O of the cosmic-ray ions and the charge spectrum of all measured particles ($Z = 5 - 16$) could be obtained. (auth)

26612 EXPERIMENTAL METHODS OF CORRELATION BETWEEN THE TRAJECTORIES OF COSMIC HEAVY IONS AND BIOLOGICAL OBJECTS: DOSIMETRIC RESULTS FROM THE BIOSTACK EXPERIMENT ON APOLLO 16 AND 17. Pfohl, R.; Kaiser, R.; Massue, J. P.; Cueer, P. (Centre de Recherches Nucleaires, Strasbourg). pp 57-63 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on life sciences and space research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

The biological objects in the Biostack are stacked alternately between physical detectors of HZE particle tracks which include nuclear emulsions. The pattern of the biological objects is transferred to the upper side of the adjacent emulsion by optical illumination. On each sheet of nuclear emulsion a coordinate grid is transferred to the bottom side by optical illumination. The visible track left by the passage of the heavy ion can then be very clearly localized. The charge of the ions is determined by photometric measurements of the tracks. These measurements are calibrated with known tracks of heavy ions accelerated at the Bevatron at Berkeley. The results are given as: flux, number of stars per cm^3, charge of the ions, comparison with other detectors (plastics, AgCl crystals, LiF), energy loss, hit region in the biological objects. (auth)

26613 AgCl DETECTORS IN THE BIOSTACK II EXPERIMENT ABOARD APOLLO 17. Henig, G. (Univ., Frankfurt am Main); Schopper, E.; Schott, J. U.; Ruether, W. pp 65-67 of Life Sciences and Space Research XII. Sneath, P. H. A. (ed.). Berlin; Akademie-Verlag (1974).

From 16th plenary meeting of COSPAR on life sciences and space research; Constance, F. R. Germany (23 May 1973). See CONF-7305107-.

Two layers of AgCl detectors with a total surface of 90 cm^2 were flown. Tracks of nuclei, from light ($Z > 4$) up to the heaviest were recorded and could be distinguished by their geometrical track-widths. The tracks were divided into five groups of atomic numbers, and their abundance was measured. Also the number of (surviving) nuclear stars was counted. 22.5 cm^2 of the detector surface were covered with eggs of Artemia salina. The detectors could be developed without removing the eggs, so that the spots hit could be determined directly. The radiation effect on these eggs is being investigated. (auth)

Stars

Refer also to abstracts 26607, 26608, 26685, 26703, 26707, 26817, 26834, 27582, 27729, 27743, 27747, and 27755.

26614 PHOTOMETRY OF THE MINIMA OF TX HERCULIS. Bakos, G. A. (Waterloo Univ., Ontario (Canada)); Tremko, J. (Skalnate Pleso Observatory, Czechoslovakia). Astrophys. Space Sci.; 31: No. 2, 427-448(Dec 1974).

Three epochs of primary and four epochs of secondary minima of TX Her were determined from photoelectric observations made between 1968 and 1973. The individual observations in three colors are tabulated. (auth)

26615 ADIABATIC PULSATIONS AND CONVECTIVE INSTABILITY OF ROTATING GASEOUS MASSES. II. Differential Rotation and Toroidal Magnetic Fields. Kochhar, R. K. (Punjab Univ., Chandigarh (India)). Astrophys. Space Sci.; 31: No. 2, 449-475(Dec 1974).

Third order virial equations have been used to investigate the oscillations and the stability of the sequence of differentially rotating, compressible Maclaurin spheroids in the presence of toroidal magnetic fields. It is shown that the neutral point occurring at eccentricity $e = 0.731\,13$, which is the analogue of the first point of bifurcation along the Dedekind sequence, remains unaffected by the presence of differential rotation or a toroidal magnetic field. The point of onset of dynamical instability corresponding to the third harmonic deformations does, however, depend upon the magnetic field. It is shifted to values higher than $e = 0.966\,96$, the value that obtains in the case of uniform rotation; and a sufficiently large magnetic field can suppress this point. Complete frequency spectra ("Kelvin" modes belonging to the harmonics $l = 3$ and compressible modes belonging to $l = 1$) are obtained in two cases of interest: when the equilibrium state is one of equipartition, and when toroidal magnetic and velocity fields (vanishing at the surface) are present in a configuration rotating with a constant angular velocity. (auth)

26616 PULSATION REGIME OF THE THERMONUCLEAR EXPLOSION OF A STAR'S DENSE CARBON CORE. Ivanova, L. N.; Imshennik, V. S.; Chechotkin, V. M. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). Astrophys. Space Sci.; 31: No. 2, 497-514(Dec 1974).

The hydrodynamical problem of nuclear explosion of a dense carbon core of a star with mass 1.40 $M_\odot$ is solved numerically. In calculation the kinetics of carbon burning at the nuclear reaction $^{12}C + {}^{12}C \rightarrow {}^{24}M + \gamma$ rate is included. Thus the inverse effect of hydrodynamical motion on the process of thermonuclear burning is taken into account, as compared with Bruenn's (1972) calculations. The calculations show that a pulsation regime of burning is realized (actually three pulses were obtained) which evolves to the detonation regime with full combustion and disruption of the star only at the third pulse. The effects of disintegration of iron group nuclei, neutronization of matter and neutrino losses in URCA processes have not yet been considered in calculations. The influence of initial conditions (mainly the temperature distributions) and the above mentioned effects, which have not been included in calculation, on the results of the hydrodynamical problem solution are discussed. The conclusion is made on new possibilities of formation of a gravitationally bound remnant of the explosion and a neutron star. (auth)

26617 DISSIPATION OF ENERGY THROUGH TIDAL DEFORMATION. Tokis, J. N. (Department of Mechanics, University of Patras, Greece). Astrophys. Space Sci.; 31: No. 2, 349-362(Dec 1974).

An equation of dissipation of energy is derived for a rotating body of arbitrary viscosity distorted by tides, which arise from the gravitational field of its companion in a close pair of such bodies. By a transformation of the fundamental equation of energy dissipation in terms of velocity of tidal deformation, the dissipation function is constructed for a tidally-distorted body. From this equation, the rate of dissipation of tidal energy is formulated for a nearly-spherical rotating body distorted by second harmonic longitudinal tides; the coefficients of viscosity (or the bulk modulus) are treated as arbitrary functions of spatial coordinates. Finally expressions for the total energy dissipation within the orbital cycle are given for axial rotation of the distorted body, provided its angular velocity is constant (for example, with the Keplerian angular velocity). (auth)

26618 BINARY STELLAR WINDS. Siscoe, G. L.; Heinemann, M. A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). Astrophys. Space Sci.; 31: No. 2, 363-374(Dec 1974).

Stellar winds from a binary star pair will interact with each other along a contact discontinuity. The geometry of the flow and

field resulting from this interaction is discussed in the simplest case where the stars and winds are identical. The shape of the critical surface (defined as the surface where the flow speed is equal to the sound speed) as a function of stellar separation, and the role of shock waves in the flow field are considered. The effect of stellar spin and magnetic sectors on the field configuration is given. The relative roles of mass loss and magnetic torque in the evolution of orbital parameters are discussed. (auth)

26619 VIBRATIONAL STABILITY OF STARS IN THERMAL IMBALANCE: A SOLUTION IN TERMS OF ASYMPTOTIC EXPANSIONS. I. "Isentropic" Oscillations. Demaret, J. (Liege Univ. (Belgium). Inst. d'Astrophysique). Astrophys. Space Sci.; 31: No. 2, 305-331(Dec 1974).

"Isentropic" oscillations of a star in thermal imbalance are defined as those for which, at every instant, the entropy of each mass element of the configuration in the perturbed motion is equal to that of the same mass element in the unperturbed motion. The solution of the equations describing such "isentropic" oscillations and written in terms of the infinitesimal displacement $\delta r(r_0,t)$ is presented in terms of asymptotic expansions up to the first order in the parameter Π/t_s, where Π is the adiabatic pulsation period for the fundamental mode and t_s, a "slow" time scale of the order of the Kelvin-Helmholtz time. The solution obtained allows one to define, unambiguously, an "isentropic" part to the coefficient of vibrational stability of arbitrary stellar models in thermal imbalance, as well as to derive a general formula relating the results of a stability analysis in terms of δr and $\delta r/r$. Application of this general solution to the simple case of homologous motion is also given. (auth)

26620 A NUMERICAL CODE FOR MULTIPLE "WATER BAG" GRAVITATIONAL SYSTEMS. Cuperman, S.; Harten, A. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Comput. Phys. Commun.; 8: No. 4, 307-319(Nov 1974).

A convenient numerical integration method for studying the collective behavior of a strongly non-homogeneous, finite size, non-maxwellian system is to follow the motion of the boundary curves defining the system in phase space. This method of integration enables one to investigate a system possibly consisting of a very large number of particles (enclosed by a boundary curve) without having to treat them explicitly. The method was first proposed by Roberts and Berk who also applied it to the study of the two-stream instability in one-dimensional plasma systems. This paper describes the computer code developed to investigate one-dimensional, collisionless systems of stars, consisting of regions of constant density matter (in phase space). (NL)

26621 THE LENSE-THIRRING EFFECT AND ACCRETION DISKS AROUND KERR BLACK HOLES. Bardeen, J.M.; Petterson, J.A. (Physics Department, Yale University). Astrophys. J. Lett. 195: No. 2, L65-L67 (15 Jan 1975).

Astrophysical evidence for the relativistic Lense-Thirring effect could come from its influence on tilted accretion disks around Kerr black holes. We show here how it causes the gradual transition of the disk into the equatorial plane of the black hole in the region between the radii 10^4M and 10^2M. We expect that a considerable part of the radiation emitted in the central part of the disk may be reabsorbed in the transition region, which may lead to observable changes in the X-ray spectrum. (auth)

26622 THE NON-LTE TRANSPORT EQUATION FOR POLARIZED RADIATION IN THE PRESENCE OF MAGNETIC FIELDS. I. FORMULATION. House, L.L. (High Altitude Observatory, National Center for Atmospheric Research); Steinitz, R. Astrophys. J. 195: No. 1, 235-249 (1 Jan 1975).

A formulation of the radiative transfer of polarized light under conditions departing from local thermodynamic equilibrium and accounting for the presence of a magnetic field is presented. The formulation is self-consistent in that the equations of statistical equilibrium for magneitc sublevels are also included. The quantum-mechanical derivation of the absorption matrix, the key to the presentation, is derived in detail utilizing the density matrix approach. The polarization of the radiation field is described in terms of the usual Stokes parameters, but the discussion of the Stokes parameters in this paper illustrates their quantum mechanical origin and interpretation. The equation of radiative transfer for the *Stokes vector* is cast in a form reminiscent of the non-local thermodynamic equilibrium (NLTE) scalar equation of transfer, except that the equation is now a vector equation in the Stokes parameters and the source function is a vector function containing the population of magnetic sublevels. An "equivalent two-level" formulation is presented in which the "standard" scalar source function is mereley corrected by a nondimensional vector function. This formulation of the vector NLTE radiative transfer equation for the Stokes vector now allows the possibility of improved interpretation of line profiles in the four Stokes parameters and thus an improved basis for the determination of vector magnetic fields in stellar atmospheres. The present discussion is restricted to the case in whica the magnetic field is sufficiently strong that the natural widths of magnetic sublevels do not overlap producing interference effects. This restriction will be discussed in a succeeding paper. (auth)

26623 SLOWLY ROTATING RELATIVISTIC STARS. IIIA. THE STATIC STABILITY CRITERION RECOVERED. Hartle, J.B. (Department of Physics, Yale University). Astrophys. J. 195: No. 1, 203-212 (1 Jan 1975).

The static stability criterion for slowly rotating relativistic stars of Hartle and Thorne is corrected to properly compute the shape of the neutral mode of oscillation of a marginally stable rotating star to zeroth order in the rotation. The correction consists in taking into account the rotation-induced mixing between the neutral radial mode and neutral convective modes. The resulting criterion gives a simple method of analyzing the effect of a slow and rigid rotation on the stability of an isentropic stellar model. Like the static criterion for nonrotating stars, the method does not involve solving the full dynamical equations for the pulsations of the rotating star. Instead, it involves constructing a family of equilibrium configurations with a specified differential rotation and then comparing the masses of these configurations with the masses of the uniformly rotating models. (auth)

26624 POLARIZATION CHARACTERISTICS OF HERBIG Ae AND Be STARS. Vrba, F.J. (Steward Observatory, University of Arizona, Tucson). Astrophys. J. 195: No. 1, 101-106 (1 Jan 1975).

The polarization wavelength dependences of 10 Herbig Ae and Be stars have been determined over the wavelength range 3700-7500 Å. Upon subtraction of an assumed interstellar polarization component, seven of nine objects display an unexplained polarization peak (centered upon the 6500 Å filter) the height of which correlates well with the strength of Hα emission. Four of the objects were studied for polarization time variability, with the result that Z CMa showed significant time variation. (auth)

26625 ULTRAVIOLET ENERGY DISTRIBUTIONS OF LUMINOUS EARLY-TYPE STARS FROM TD1 SATELLITE OBSERVATIONS. Humphries, C.M.; Nandy, K.; Kontizas, E. (Royal Observatory, Edinburgh, Scotland). Astrophys. J. 195: No. 1, 111-119 (1 Jan 1975).

Ultraviolet spectra are presented for supergiants, giants, and main-sequence stars in the spectral type range from B0 to A2. The observations were obtained in the spectral range 2750-1350 Å with the S2/68 Ultraviolet Sky Survey Telescope in the TD1 satellite. The effect of luminosity has been studied by comparing the ultraviolet energy distributions of luminous and main-sequence stars of the same spectral type. The flux deficiencies which are observed in the energy distributions of luminous stars are interpreted as the result of lower effective temperatures for luminous stars than for corresponding main-sequence stars, and an estimate is given of the effective temperature scale for B-type supergiants. (auth)

26626 ULTRAVIOLET PHOTOMETRY FROM THE ORBITING ASTRONOMICAL OBSERVATORY. XVIII. THE 1972 ECLIPSE OF 31 CYGNI. Doherty, L.R.; Jung, A.F. (Space Astronomy Laboratory, Washburn Observatory, University of Wisconsin-Madison). Astrophys. J. 195: No. 1, 121-125 (1 Jan 1975).

Wide-band filter photometry of the 1972 eclipse of 31 Cyg has been reduced for seven filters with effective wavelengths 4250-1430 Å. These ingress observations cover the interval April 21.1-May 10.9. Comparison of the light curves with earlier OAO eclipse observations of the similar system 32 Cyg suggests that both K supergiant atmospheres can be described with a single density profile $\rho/\rho_0 = f(r/r_0)$. Line absorption appears to be the principal source of opacity at all ultraviolet wavelengths. (auth)

26627 INTERPRETATION OF BM ORIONIS. Huang, S. (Department of Astronomy, Northwestern University). Astrophys. J. 195: No. 1, 127-135 (1 Jan 1975).

The entire light curve of the BM Ori system both inside and outside primary and secondary eclipses has been examined on the basis of two models for the disk around the secondary component: one with the luminous energy of the disk coming entirely from the secondary, and another with the luminous energy coming at least partly from the primary. It has been found that if the disk is highly opaque, as is suggested by the fitting of the light curve, there exist in the first model discrepancies between what has been derived from the luminosity consideration for the secondary component and what has been derived from the radius consideration. Hence the second model is accepted. Based on this model the nature of both component stars has been examined from a consideration of the luminosity and the dimensions of the disk. It has been found that while the contribution to the disk luminosity by the primary component is only a fraction of its luminosity, it is more than can be expected from the primary's electromagnetic radiation. This fact, together with the observed change in the amplitude of the velocity curve of the system, led us to propose that energy is being transported to the disk by matter from the primary B component through hydrodynamic flow. The mass ejection by the primary may follow a cause similar to what happens in Be stars,

namely, rotational motion coupled with radial instability triggered by the radiation pressure. In the present case, the ejection is further aggravated by the presence of a companion. (auth)

26628 ON THE SCALE OF PHOTOSPHERIC CONVECTION IN RED GIANTS AND SUPERGIANTS. Schwarzschild, M. (Princeton University Observatory). Astrophys. J. 195: No. 1, 137-144 (1 Jan 1975).

An attempt is made to estimate the sizes of the convective elements which dominate the brightness variations on the photospheres of red giants and supergiants. The data assembled permit the extreme hypothesis that these dominant convective elements are so large that only a modest number of them exists at any one time on the entire surface of such a star—in contrast with two million granules on the Sun. (auth)

26629 RADIATION-DRIVEN WINDS IN Of STARS. Castor, J.I.; Abbott, D.C.; Klein, R.I. (Joint Institute for Laboratory Astrophysics, University of Colorado). Astrophys. J. 195: No. 1, 157-174 (1 Jan 1975).

The large number of subordinate lines of a representative ion are found to have a dominant effect on the force of radiation on material in O star atmospheres. The force is increased over that due to resonance lines alone so that rates of mass loss are obtained which are 100 times greater than previously thought possible. The force is related to the solution of the line-transfer problem, and it becomes a function of the local velocity gradient. A new stellar wind theory, with a different interpretation of the singular point, is developed to treat this situation. The rate of mass loss, and other properties of the model, are uniquely specified by the luminosity, mass, and radius of the star. Alternative static models do not exist. Numerical results give a rate of mass loss 6×10^{-6} $M_\odot$ per year for an O5 star, with a terminal velocity of 1500 km s^{-1}. The rate of mass loss is sensitive to stellar parameters, while the terminal velocity is not. The continuum optical depth in the expanding envelope is about 0.16, of the right order to explain the reduced brightness temperature observed in ξ Pup. There is sufficient mass in the envelope for recombination to produce the emission lines of H and He II which are observed, with approximately the proper strength. The rate of mass loss corresponds to a loss of more than 25 percent of the star's mass during main-sequence hydrogen burning, with obvious consequences for stellar evolution, and with the possibility of modified surface abundances. (auth)

26630 PULSATIONAL STABILITY OF STARS IN THERMAL IMBALANCE. VI. PHYSICAL MECHANISMS AND EXTENSION TO NONRADIAL OSCILLATIONS. Aizenman, M.L.; Cox, J.P. (Joint Institute for Laboratory Astrophysics, University of Colorado). Astrophys. J. 195: No. 1, 175-185 (1 Jan 1975).

A clarification of the physical mechanisms operative in the pulsational stability against radial oscillations of spherical stars in thermal imbalance is presented. It is shown that the stability coefficient for such stars can be conceptually separated into distinct "dynamical" and "nonadiabatic" parts. The dynamical part involves *no* nonadiabatic effects, and is analogous to a slowly time-varying spring constant in a simple mechanical system. The nonadiabatic part arises from phase shifts between the pressure and density variations brought about solely by the small nonadiabatic effects which cannot be neglected in a star in thermal imbalance. This separation permits a clear and simple physical interpretation of the expression for the stability coefficient for quasiadiabatic oscillations of a certain class of stellar models (which do *not* assume homologous secular motion), and serves as a valuable guide for attacking problems involving thermal imbalance effects in more complicated cases of stellar oscillations. It is shown with the help of this guide that the formal expression for the stability coefficient for purely radial oscillations also applies *identically* to the nonradial oscillations of a spherical star in thermal imbalance. We suggest that these thermal imbalance effects as applied to nonradial oscillations may play a role in the instability of the β Cephei stars. (auth)

26631 CARBON-BURNING NUCLEOSYNTHESIS WITH CONVECTION. Endal, A.S. (Department of Physics and Astronomy, University of Florida, Gainesville). Astrophys. J. 195: No. 1, 187-192 (1 Jan 1975).

The effect of convection on carbon-burning nucleosynthesis is explored with a limited network of reactions. Convection is simulated by a series of networks at fixed mass points in the core of an evolving 15 $M_\odot$ star. Complete mixing is always assumed. Comparison to single network calculations show that the "half-energy" approximation of Arnett yields reasonable results, although the abundances of nuclei which are created by β-decay of unstable nuclei tend to be underestimated, by this approximation. (auth)

26632 STRUCTURE AND PROPERTIES OF DETONATION WAVES. I. DETONATION WAVES IN DENSE STELLAR MATERIAL. Bruenn, S.W.; Marroquin, A. (Florida Atlantic University, Boca Raton). Astrophys. J. 195: No. 2, 567-584 (15 Jan 1975).

Techniques are developed for following the time history of the nuclear abundances and the thermodynamic variables of a fluid element passing through the burning zone of a detonation wave. Application is made here to stellar material at high densities. Assumptions made in prior investigations are examined in detail. It is shown, finally, that a detonation wave fueled by ^{16}O is self-consistent even when crystallization effects are taken into account. (auth)

26633 COMMENT ON " A NOTE ON IONIZATION EQUILIBRIUM". Rouse, C.A. (Del Mar, California). Astrophys. J. 195: No. 2, 585-585 (15 Jan 1975).

The recent derivation by Lafferty of an expression for the time rate of change of the average charge of multiply charged ions is considered. After simplifying a more general expression derived here, the condition for the validity of Lafferty's equation is demonstrated. It is shown that, contrary to his conclusion, detailed balance is still required to obtain the Elwert relation. (auth)

26634 VISCOUS EFFECTS IN RAPIDLY ROTATING STARS WITH APPLICATION TO WHITE-DWARF MODELS. III. FURTHER NUMERICAL RESULTS. Durisen, R.H. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Sanat Cruz). Astrophys. J. 195: No. 2, 483-492 (15 Jan 1975).

Improved viscous evolutionary sequences of differentially rotating, axisymmetric, nonmagnetic, zero-temperature white-dwarf models are constructed using the relativistically corrected degenerate electron viscosity. The results support the earlier conclusion that angular momentum transport due to viscosity does not lead to overall uniform rotation in many interesting cases. Qualitatively different behaviors are obtained, depending on how the total mass M and angular momentum J compare with the M and J values for which uniformly rotating models exist. Evolutions roughly determine the region in M and J for which models with a particular initial angular momentum distribution can reach carbon-ignition densities in 10^{10} years. Such models may represent Type I supernova precursors. Secular instability in the presence of dissipation occurs for these models when the ratio of rotational kinetic energy to gravitational energy $T/|W| \geq 0.14$. Curves in the (M,J)p plane for which $T/|W|=0.14$ reveal an absolute upper mass limit on secularly stable axisymmetric models of a fixed angular momentum distribution. The most massive stable axisymmetric white dwarf by this criterion has a mass of 2.5 $M_\odot$ for the angular momentum distribution of a homogeneous uniformly rotating sphere. (auth)

26635 THE RELATIVISTIC ROCHE PROBLEM. II. STABILITY THEORY. Fishbone, L.G. (Center for Theoretical Physics of the Department of Physics and Astronomy, University of Maryland, College Park). Astrophys. J. 195: No. 2, 499-505 (15 Jan 1975).

We present an investigation of the dynamical stability of infinitesimal, incompressible, homogeneous, self-gravitating fluid bodies moving in circular equatorial orbits around a Kerr black hole. For near-photon orbits, instability (tidal disruption) sets in at the Roche-limit point. For the last stable orbit, instability sets in for a certain configuration somewhat more distorted from sphericity than the Roche-limit configuration. (auth)

26636 ROTATIONAL VELOCITIES OF MARGINAL METALLIC-LINE STARS. Abt, H.A. (Kitt Peak National Observatory). Astrophys. J. 195: No. 2, 405-409 (15 Jan 1975).

Projected rotational velocities are estimated for the 44 marginal metallic-line stars (Am:) listed by Cowley *et al.* These rotational velocities are slightly larger than for the more pronounced Am stars. The frequency distribution of equatorial rotational velocities of Am: stars shows little overlap with that of normal A5-A9 IV, V stars, and the overlap can be explained by differences in spectral classification. Thus rotation velocity will determine whether a star will have a normal (A5-A9) or abnormal (Am or Am:) spectrum, but will not determine whether the abnormality will be marked (Am) or marginal (Am:). Analysis of published data on binaries indicates that the Am: stars have the same high frequency of short-period binaries as do the Am stars and that in both cases the low rotational velocities are caused mostly by tendencies toward synchronous rotation in binaries. (auth)

26637 PARALLAX AND MOTIONS OF THE CAPELLA SYSTEM. Heintz, W.D. (Department of Astronomy, Swarthmore College). Astrophys. J. 195: No. 2, 411-412 (15 Jan 1975).

A combined parallax of $0''.079\pm0''.005$, relative proper motions, and the orbital motion of the faint double companion are derived from Sproul astrometric plates. (auth)

26638 TT ARIETIS: AN EVOLVED, VERY SHORT PERIOD BINARY. Cowley, A.P.; Crampton, D.; Hutchings, J.B.; Marlborough, J.M. (Dominion Astrophysical Observatory, Victoria). Astrophys. J. 195: No. 2, 413-421 (15 Jan 1975).

A spectroscopic investigation of the rapid variable TT Ari reveals it to be a binary system with an orbital period of $0^d.1375$. The spectrum is nearly continuous, with weak hydrogen emission lines superposed on shallow broad absorption. Broad C III and He II emission and narrower He I absorption are present, but very weak. The strength of the H emission is found to vary with the orbital phase, reaching a

maximum intensity near quadrature (with the hot primary receding). The presence of a nonuniform, rotating ring surrounding the primary is inferred from the H emission lines. The complex light variations show a broad maximum during each orbital period, in addition to rapid flickering. This variation may be due to a hot spot in a ring or disk around the primary excited by infalling matter from the secondary. The inferred model of the system is similar to that derived for old novae. (auth)

26639 CIRCUMSTELLAR GRAINS AND THE INTRINSIC POLARIZATION OF STARLIGHT. Forrest, W.J. (Department of Physics, University of California, San Diego); Gillett, F.C.; Stein, W.A. Astrophys. J. 195: No. 2, 423-440 (15 Jan 1975).

Twenty-five long-period variable stars exhibiting intrinsic variable polarization have been monitored over the range 3.5-11 μ for several cycles. No conclusive evidence for gross changes in amount of circumstellar grains has been found. Thus circumstellar infrared emission is attributed to the total abundance of grains surrounding the star, which does not change by a large amount with time, while intrinsic polarization is attributed to more localized scattering and absorption effects. Spectrophotometry with $\Delta\lambda/\lambda \simeq 0.015$ over the 8-14 μ wavelength range of several stars with different chemical compositions indicates excess emission characteristic of 3 types of grains: (1) "blackbody" grains, (2) silicate grains, and (3) silicon carbide grains. (auth)

26640 MODAL STABILITY OF RR LYRAE STARS. Stellingwerf, R.F. (Joint Institute for Laboratory Astrophysics, University of Colorado). Astrophys. J. 195: No. 2, 441-466 (15 Jan 1975).

The modal stability of a survey of RR Lyrae models has been investigated using linear nonadiabatic analysis and relaxation to the exact periodic nonlinear limit cycles. With these techniques both the growth rates of the small-amplitude solutions and the mode switching rates of the large-amplitude solutions are obtained, resulting in a complete description of the long-term modal behavior of the model. The systematics of the nonlinear models are described, and an accurate fitting formula for the periods is derived. The nonlinear stability results show a narrow (300°K wide in T_e) region of "fundamental or first harmonic" behavior whose blue edge is nearly the same as the linear fundamental blue edge. This situation suggests that the Oosterhoff dichotomy of globular clusters is caused by an evolutionary hysteresis effect. In a large region toward the red these models show aperiodic mixed-mode behavior similar to that observed for several stars; the mass and radius for the mixed-mode RR Lyrae star AC And derived and are in good agreement with pulsational and evolutionary results. (auth)

26641 APPLICATIONS OF LINEAR PULSATION THEORY TO THE CEPHEID MASS PROBLEM AND THE DOUBLE-MODE CEPHEIDS. King, D.S. (Department of Physics and Astronomy, University of New Mexico, Albuquerque); Hansen, C.J.; Ross, R.R.; Cox, J.P. Astrophys. J. 195: No. 2, 467-474 (15 Jan 1975).

Linear pulsation constants and transition lines for Cepheids of composition $X=0.7$, 0.8 and $Z=0.02$ are presented. These results are applied to the problem of the Cepheid mass discrepancy where it is found that self-consistent masses may be obtained if a color-temperature scale is used which reduces Cepheid effective temperatures by 300°-650°K below those usually assumed. This cooler scale closely resembles a recently proposed theoretical scale. Using the linear results, the masses and radii of eight double-mode Cepheids are also obtained. For one of these stars, U TrA, we find that in order to obtain a ratio of first-harmonic to fundamental periods close to the observed value, and at the same time for it to be unstable in both modes it must be overluminous for its mass and lie near the red instability edge. (auth)

26642 THE UNDERABUNDANCE OF GASEOUS IRON IN THE PLANETARY NEBULA NGC 7027. Shields, G.A. (Center for Astrphysics, Harvard College Observatory). Astrophys. J. 195: No. 2, 475-478 (15 Jan 1975).

Computer models which take into account the density fluctuations in NGC 7027 are used to derive an iron abundance log $[N(\mathrm{Fe})/N(\mathrm{H})] = -6.1 \pm 0.4$ in this nebula. This abundance is below the solar value by more than an order of magnitude whereas the abundances of lighter elements appear normal. The iron depletion factor in NGC 7027 is close to that in the interstellar gas and may result from the condensation of iron into grains. (auth)

26643 ON THE CONTINUOUS ENERGY DISTRIBUTIONS OF PECULIAR A STARS. Adelman, S.J. (NASA, Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 195: No. 2, 397-403 (15 Jan 1975).

Spectrophotometric scans which cover the wavelength region λλ3300-7100 of 11 magnetic Ap and 11 normal stars are used in connection with published energy distributions to examine the similarity of the continuous energy distributions of peculiar A and normal main-sequence stars. As observed from the ground, the flux distributions of the Hg-Mn stars empirically match those of the normal stars while those of the magnetic Ap and normal stars match in a gross sense. Many magnetic Ap stars are found to possess broad, continuous absorption features which are most likely produced by bound-free discontinuities, of common metals, in particular Si I, neutral iron-peak elements, and the singly ionized rare earths. (auth)

26644 TIME-DEPENDENT HYDRODYNAMIC PHENOMENA IN THE ENVELOPES OF THE Be STARS. Morgan, T.H. (Rosemary Hill Observatory, Department of Physics and Astronomy, University of Florida, Gainesville). Astrophys. J. 195: No. 2, 391-395 (15 Jan 1975).

Temporal and angular variations in the motion and distribution of circumstellar material about Be stars are studied by means of a simple hydrodynamical approach. The flow variables are each written as the sum of a known, steady-state axisymmetric term and a smaller component which contains both temporal and angular dependence. Substitution of these dichotomous expressions for the flow variables into Euler's equation and the continuity equation leads to a set of linearized equations for the terms which depend on time and angle. Solutions can be found to a somewhat approximated version of the linearized equations, and these solutions explain the qualitative features of the observed short-variations. (auth)

26645 THE COMPOSITE SPECTRUM AND ENERGY DISTRIBUTION OF XX OPHIUCHI. Lockwood, G.W. (Lowell Observatory); Dyck, H.M.; Ridgway, S.T. Astrophys. J. 195: No. 2, 385-389 (15 Jan 1975).

Broad-band photometry from 0.36 to 10.2 μ, narrow-band photometry and scans from 0.75 to 1.08 μ, and Fourier transform spectrometry from 1.4 to 2.5 μ show that the peculiar Be star XX Oph has a cool companion with a spectral type of M6. The observed energy distribution can be represented by a B0 III star and an M6 III star reddened by 4 mag of visual extinction. (auth)

26646 A SPECTROMETRIC STUDY OF THE LYMAN-ALPHA LINE OF BETA PERSEI. Chen, K.; Wood, F.B. (Department of Physics and Astronomy, University of Florida, Gainesville). Astrophys. J. Lett. 195: No. 2, L73-L76 (15 Jan 1975).

A brief description is given of the Lα line based on observations made by the *Copernicus* satellite. No emission was detected. No significant differences were found between observations outside eclipse and those during primary minimum. Some of the blended lines in this spectral region are identified. (auth)

26647 THE STRUCTURE OF SYNCHRONOUSLY ROTATING CLOSE BINARIES BUILT ON POLYTROPIC MODEL $\nu=3$. Green, L.C.; Kolchin, E.K. (Strawbridge Observatory, Haverford College). Astrophys. J. Suppl. Ser. 28: No. 271, 449-463 (Dec 1974).

The purpose of the present paper is to develop mathematical procedures which are capable of providing an exact solution for the structure of synchronously rotating close binaries built on polytropic model $\nu=3$ with a view to treating, in the future, cases of small separation which may be of significance for an understanding of the fission problem. Methods are described for computing the variation with depth of the rotational and tidal deformation of the "level" surfaces. Two sets of spherical coordinates are employed with their origins at the centers of the two spherical objects which are taken as the undistorted, zeroth-order components. The potential and the density are expanded in series of surface spherical harmonics multiplied by numerical radial functions. These radial functions are determined from the nonlinear differential equation for the potential by an iterative procedure which holds the total mass and central temperature constant. These procedures are applied to systems in which both components have the solar mass and, in the zeroth approximation, the solar radius as well. Results are discussed for separations of centers of 10.0, 4.0, 3.0, and 2.8 solar radii and for four truncation points in the series expansions, such that all relevant spherical harmonics through those of degree 2, 4, 6, and 8 are included. Extensive tables are given of the numerical radial functions fo each spherical harmonic component of the potential for a separation of 2.8 solar radii, and comments are made on the behavior of these functions. The degree of the convergence of the present method of solution is estimated for each separation of the components from the run of the results for the variously truncated series. Tables are presented which show the change with depth of the "axes" of the level surfaces for the different separations. These surfaces serve as the loci of constant potential, pressure, and density. Comparison of the present results with those of first-order perturbation theory indicate the latter's range of validity. For the various separations, the "furrow" is traced as it "dents" each level surface. In the deep interior, it is shown to lie on the opposite side of the diametrical plane from the second component. Tables of the radial component of the variation of gravity over the surface of the stars for each separation are presented and commented upon. Only binaries with identical components are treated in the present paper but no limitation to such systems appears to be inherent in the mathematical procedures or the computational programs. (auth)

26648 MICROMETRIC MEASURES OF DOUBLE STARS. Van Biesbroeck, G. (Lunar and Planetary Laboratory, University of Arizona). Astrophys. J. Suppl. Ser. 28: No. 270, 413-448 (Nov 1974).

Approximately 2200 visual micrometer measures are given for 700 double–star systems, mostly with small angular separations and measured during 1965–1973. (auth)

26649 ULTRAVIOLET VARIATIONS OF ε UMa. Molnar, M.R. (Ritter Astrophysical Research Center, University of Toledo, Toledo, Ohio 43606). Astron. J. 80: No. 2, 137-139 (Feb 1975).

OAO–2 spectrometer observations of the Ap variable ε UMa indicate that the photometric variations are due to variable ultraviolet absorption from apparently overabundant metals. These data also point out the presence of a secondary maximum of the Fe–group elements, notably Cr, that has not been reported. (auth)

26650 SPECTROSCOPIC STUDY OF THE OPEN CLUSTER NGC 2422. Dworetsky, M.M. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology, Pasadena, California). Astron. J. 80: No. 2, 131-133 (Feb 1975).

Rotational velocities, MK spectral types, and radial velocities are given for the 15 brightest stars in the open cluster NGC 2422. Two of these are probably foreground objects. The brightest member was previously classified B2 IV? e?; no emission lines were seen in 1972 –. 1973. The cluster contains one Si star and another Be star. The mean $V_e \sin i$ of the cluster members is very low; NGC 2422 may contain a large percentage of spectroscopic binaries. (auth)

26651 LONG PERIOD DOUBLE STARS. Buecher, A.; Laques, P. (Observatory du Pic-du-Midi, Bagneres de Bigorre, France). Astron. Astrophys.; 33: No. 1, 15-20 (Jun 1974).

Stock and Wroblemski have used an objective prism to carry out a spectroscopic analysis of large separation double stars. They have concluded that a number of these are physically related, and this information was used, together with other observational data, to compute the periods of these probable binaries. This method was applied also to known binaries and the probable error was assessed. This work confirms Stock and Wroblemski's conclusion about the physical nature of the majority of these main sequence stars, and a classification in terms of the period. (auth)

26652 PROPERTIES AND NATURE OF SHELL STARS 4.88 HERCULIS: THE 87-DAY PERIOD CONFIRMED. Harmanec, P.; Koubsky, P.; Krpata, J. (Astronomical Inst., Ondrejov, Czech.). Astron. Astrophys.; 33: No. 1, 117-121 (Jun 1974).

Radial-velocity variations of 88 Her as measured on the Haute Provence coudé spectrograms of 1963–1972 by Doazan (1973) seem to confirm the periodic character of the changes reported previously. Combining Doazan's measurements with the original values and with the velocities of eighteen new Ondrejov coudé spectrograms of 1972–1973 a much more precise value of the period was determined: 86.59 ± 0.06 days. The long-term variations of the envelope of the star disclosed by Doazan are confirmed on the spectrograms. The obvious stability of the periodic radial-velocity changes with respect to these variations speaks in favor of their binary origin. Thus, the star is considered to be a spectroscopic binary and an improved set of orbital elements is given. The new elements coincide with older ones within the limits of errors computed for the older elements though they are based on measurements covering the time interval about ten times longer than those of the original set. (auth)

26653 VARIATIONS OF THE OPTICAL EMISSION-LINE SPECTRUM OF THE ECLIPSING BINARY X-RAY STAR HD 153919 (=2U 1700-37). Dachs, J.; Schober, H. J. (Ruhr Univ., Bochum, Ger.). Astron. Astrophys.; 33: No. 1, 49-54 (Jun 1974).

The strengths of several emission lines in the spectrum of the Of-type star HD 153919 which is the occulting body of the eclipsing x-ray source 2 U 1700-37 were studied for periodic variations with a photoelectric spectrum scanner at a resolution of 10 Å. No regular variations with phase exceeding the mean error of the measurements (about 10%) were found for the strength of the emission lines of N III λ 4634/4641 Å + C III λ 4650 Å and of He II λ 4686 Å. From ten measurements of the equivalent width of the Hα emission line, a periodic variation was indicated with a maximum at or shortly after the center of the occultation of the x-ray source by the Of star. These results confirmed earlier conclusions of Hutchings (1968) that the Hα emission in Of-type stars is produced in an expanding envelope which is much more extended than the layers emitting the N III, C III, and He II λ 4686 Å lines. The most likely explanation of the strong variation of the Hα emission appears to be a synchronous rotation of the optical Of-star and its asymmetric envelope with the orbital revolution of the companion x-ray source. If the envelope is assumed to be optically thin for Hα radiation, its scale height is of the order of 10^{12} cm, and the mean hydrogen density in the envelope is about 3×10^{11} cm^{-3}. (auth)

26654 STABILITY OF DIFFERENTIAL ROTATION WITH NONAXISYMMETRIC PERTURBATIONS. I. The Sufficient Conditions. Sung, C. H. (Univ. of Chicago). Astron. Astrophys.; 33: No. 1, 99-104 (Jun 1974).

A normal-mode analysis is used to establish some sufficient conditions for stability of a differentially rotating, compressible flow between two coaxial cylinders subject to nonaxisymmetric perturbations. A convenient sufficient condition for stability is $(1/\rho)\, G_{\varpi} S_{\varpi} - (1/4)\, \varpi^2 (D\Omega)^2 \geq 0$ everywhere. Here, ϖ is the radial distance from the axis of rotation Ω, $D \equiv d/d\varpi$, $G_{\varpi} \equiv -(1/\rho)\, Dp$, ρ the density, p the pressure and S_{ϖ} the Schwarzschild discriminant defined as $(\rho/\gamma p)\, Dp - D\rho$, γ is the ratio of specific heats. In the limiting case of large ϖ, the Richardson criterion in its original form derived in plane-parallel flow is recovered. For differential rotation, the effect of rotation tends to be stabilizing; while for uniform rotation, the stabilizing influence is absolute except for the perturbations with wave number along the axis of rotation $k_z = 0$. This model of cyclindrical flow is shown to be applicable to stellar models with rotation law $\Omega = \Omega(\varpi)$. (auth)

26655 ABSOLUTE ULTRAVIOLET SPECTROPHOTOMETRY FROM THE TD-1 SATELLITE. III. The Continuum of A Type Stars Between 1350 and 2500 A. Malaise, D. (Univ., Liege); Gros, M.; Macau, D. Astron. Astrophys.; 33: No. 1, 79-86 (Jun 1974).

For 52 stars for which well calibrated spectra exist from the TD-1 satellite, a statistical study of their ultraviolet spectrum was performed. The analysis of the values of two spectra indices, built to describe two different parts of the upper stellar atmosphere, lead to the following conclusions: 1) the spectral classification breaks down at 1400 Å, where large variations are present from star to star within the same spectral type; 2) an extra opacity is needed to reconcile the theory with the observations around 2100 Å. (auth)

26656 ABSOLUTE ULTRAVIOLET SPECTROPHOTOMETRY FROM THE TD-1 SATELLITE. IV. Line Features in UV-SPECTRA OF A STARS. Jamar, C. (Univ., Liege); Macau, D.; Praderie, F. Astron. Astrophys.; 33: No. 1, 87-91 (Jun 1974).

About 20 absorption features are detected in S 2/68 spectra of A type stars between 1350 and 2550 Å. Tentative identifications are given as well as a discussion of their behavior from star to star. Ap stars and supergiants are specially considered. (auth)

26657 ABSOLUTE ULTRAVIOLET SPECTROPHOTOMETRY FROM THE TD-1 SATELLITE. V. Bolometric Corrections for Early Type Stars of Luminosity Class V. Beeckmans, F.; Macau, D.; Malaise, D. (Univ., Liege). Astron. Astrophys.; 33: No. 1, 93-98 (Jun 1974).

A few main sequence stars for which accurate absolute ultraviolet spectrophotometric data are available (given by the S2/68 experiment of the TD–1A satellite) and visible energy distributions are used for the determination of semi-empirical bolometric corrections. For the spectral range where no observational data are available, fluxes predicted by LTE models of Kurucz and Carbon and Gingerich are used which fit all the observational data the best. Effective temperatures are deduced from the bolometric fluxes for stars with known diameter. (auth)

26658 INTEGRATED COLORS OF STAR CLUSTERS IN THE LARGE MAGELLANIC CLOUD. Bernard, A.; Bigay, J. H. (Observatoire, Lyon). Astron. Astrophys.; 33: No. 1, 123-130 (Jun 1974). (In French).

Photometry of the integrated light of 95 star clusters in the UBV-photometric system is reported. The results of the integrated uvby observations for 29 bright clusters previously measured in the UBV-photometry (van den Bergh and Hagen, 1968) are given. The U–B versus B–V diagram shows that the clusters form two groups: young clusters with $B-V < 0.5$, most of which are located in a triangular region delimited by the reddening line $U - B = 0.72\ (B - V) - 1.0$ and by the intrinsic color-line found for the galactic open clusters, and a few old red clusters with $B - V > 0.6$, thus confirming previous results obtained by different investigators. The most heavily reddened clusters are found among the youngest ones ($E_{(B-V)}$ reaching 0.5 for some of them). The dichotomy between these two groups is still more striking in the different diagrams of the why-photometry. Generally two well-marked sequences appear. The reddening-free parameters $[u - b]$, $[m_1]$, $[c_1]$ of globular clusters are shown to correlate with one another. The latter two indices are therefore metallic line-strength indicators. There is also good agreement between these parameters and the spectral-types Sp(H) determined by Andrews and Evans. (auth)

26659 NOTE ON THE DETERMINATION OF THE ABSOLUTE MAGNITUDE OF RR LYRAE VARIABLES. Clube, S. V. M. (Royal Observatory, Edinburgh); Jones, D. H. P. Astron. Astrophys.; 33: No. 1, 153-155 (Jun 1974).

The recent determination of the absolute magnitude of RR Lyrae variables by Heck is likely to be seriously influenced by an error in the Rigal–Jung maximum likelihood technique for deriving a statistical parallax. The nature of this error is discussed especially in relation to the procedure used by Clube and Jones. (auth)

26660 SOME CONSEQUENCES OF A RAPID DOPPLER WIDTH VARIATION ON THE FORMATION OF STELLAR CHROMOSPHERIC LINES. Magnan, C. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 33: No. 1, 139-141(Jun 1974).

A simple formula related to the optical depth and to the width of a line formed in a chromospheric situation is derived. Some applications are indicated especially concerning the Wilson–Bappu relation. (auth)

26661 REMARKABLE STAR IN A HIGHLY REDDENED GROUP OF OB⁺-STARS IN NORMA. Klare, G. (Landessternwarte, Heidelberg); Neckel, T. Astron. Astrophys.; 33: No. 1, 133-145 (Jun 1974).

An interesting star (its spectrum suggests an object of the VV Cephei type) was found in a group of highly reddened OB⁺-stars in Norma. The polarization behavior in the surroundings of this group was discussed. (auth)

26662 INFRARED EMISSION IN R CrB TYPE STARS. Maron, N. (Coll. of Engineering, Zielona Gora, Poland). Nature (London); 252: No. 5480, 214-215(15 Nov 1974).

It is stated that the observed infrared emission from R CrB type stars is considered to be re-radiation of absorbed visual light by graphite grains. A lack of correlation between changes of star brightness and infrared emission has been explained as due to condensation of the grains in discrete clouds escaping from the star in random directions. This would lead to observation of infrared emission without any corresponding change in brightness. During April and May 1972, however, the brightness of an R CrB star was observed to decrease about 6 mag. without any observed changes of infrared flux. A possible interpretation of this is offered. (UK)

26663 GRAVITATIONAL RADIATION OF ROTATING BODIES. Fedorova, S. P. (Kazakh Pedagogical Inst., Alma-Ata, USSR). Dokl. Akad. Nauk SSSR; 218: No. 4, 821-823(1 Oct 1974). (In Russian).

The effect of the natural rotation of a body on its gravitational radiation is examined using the Foch method of successive approximations for systems of two spherically symmetric bodies. (JSR)

26664 EMISSIONNYE LINII V SPEKTRAKH ZVEZD TIPA VOL'FA–RAIE. (Emission Lines in the Spectra of Wolf–Rayet Stars). Tartu; Tartu Astrophysical Observatory (1973). 167p.

Separate abstracts were prepared for the five chapters. (WDM)

For abstracts of individual papers see: 26665–26669.

26665 NEBULAR MODEL FOR WOLF–RAYET STARS. Nugis, T. pp 3-17 of Emissionnye linii v spektrakh zvezd tipa Vol'fa–Raie. Tartu; Tartu Astrophysical Observatory (1973). (In Russian).

Some considerations are given to prove that the nebular model of Beals is more acceptable for explaining the phenomenon of Wolf–Rayet. The cause of the absence of any detectable shift of phase which ought to be introduced by the transit-time effect in radial velocity curves of the binary V 444 Cyg (OB + WN 5) is discussed. In the case of the lines λλ4603, 4619, and 4686 this is probably caused by the uv absorption since the emission and the absorption components of these lines are effectively formed in different regions of the corresponding zones. uv absorption also seems to be the cause why γ-velocities in case of these lines have been found to be shifted to the red compared with the values determined from the lines of the OB component. In the case of the line λ4057, the absence of the transit-time effect may be caused by blending with the lines λλ4100 (NIII + HeII), 4026 (HeI + HeII) since NIII and HeI lines are formed in more distant regions of an envelope than NIV lines. (auth)

26666 LINES OF H I AND He II IN SPECTRA OF WOLF–RAYET STARS. Il'mas, M.; Nugis, T. pp 19-51 of Emissionnye linii v spektrakh zvezd tipa Vol'fa–Raie. Tartu; Tartu Astrophysical Observatory (1973). (In Russian).

The equations of stationarity for the level populations of HI and HeII are solved on the predicted conditions in the envelopes of the WR stars HD 192163 and HD 191765 (both WN 6), HD 192103 (WC 7) and HO 192641 (WC 6-7). In the first section the values of T*, T_e, n_e, W, and β_{12}^0 were considered as variable parameters. In the case of HeII lines the mean values of the coefficients $\overline{\beta_c\beta_{1c}}$ were calculated for the whole zone. For that purpose $n^*\mu/v$ was used as a variable parameter instead of β_{12}^0. In those calculations the values of T*, T_e, μ_0, μ_1, $n_{e\infty}$ v_0 and also the law of expansion were fixed. The calculated values of $\overline{\beta_c\beta_{1c}}$ for some HeII lines are given. In the case of WN 6 stars a better coincidence is obtained with the model V and in the case of the WC stars. (auth)

26667 ANALYSIS OF He I LINES IN SPECTRA OF SOME WOLF–RAYET STARS. Nugis, T. pp 53-81 of Emissionnye linii v spektrakh zvezd tipa Vol'fa–Raie. Tartu; Tartu Astrophysical Observatory (1973). (In Russian).

A system of the equations of stationarity for the level populations of HeI (6) is solved on the predicted conditions in the zone HeII. For that purpose the values of W and T_e in the HeII zone were estimated. The values of T*, T_e, W, n_e, and τ_{1s}^0 were considered as variable parameters. The sets of these parameters are given. Further the mean values of the coefficients $\overline{\beta_k\beta_{1k}}$ were calculated for the assumed models of the HeII zone. The calculated values of the coefficients $\overline{\beta_k\beta_{1k}}$ for the lines HeI λλ 10830, 5876, 6678, and 3889 are given. The calculated values of the optical depths of the HeII zones in the continuum of the first level ($\tau\nu_1$) are presented. (auth)

26668 SOLUTION OF EQUATIONS OF STATIONARITY FOR N V, C IV, TRIPLETS OF N IV AND DOUBLETS OF N III. Nugis, T. pp 83-143 of Emissionnye linii v spektrakh zvezd tipa Vol'fa–Raie. Tartu; Tartu Astrophysical Observatory (1973). (In Russian).

A system of the equations of stationarity for the level populations of NV, CIV, the triplets of NIV, and the doublets of NIII is solved on the predicted conditions in the envelopes of some WR stars. The values of T*, T_e, n_e, W, and τ_{12}^0 are considered as variable parameters. The sets of these parameters are given. The corresponding solutions are presented. The calculated ratios of the intensities of the lines of these ions agree rather well with the observed ones. For the WN6 stars HD 192163 and HD 191765 and the WN5 star HD 193077 the ratios of n(N)/n(He) and n(C)/n(He) were also found. (auth)

26669 SOLUTION OF EQUATIONS OF STATIONARITY FOR SINGLETS OF C III. Nugis, T.; Feklistova, T. pp 145-165 of Emissionnye linii v spektrakh zvezd tipa Vol'fa–Raie. Tartu; Tartu Astrophysical Observatory (1973). (In Russian).

A system of the equations of stationarity for the level populations is solved for the singlets of C III. The levels which have been considered in the calculations are given. The oscillator strengths for the transitions between those levels are found in LS coupling neglecting interconfiguration interaction. From the analysis of the solutions of the equations of stationarity it was concluded that interconfiguration interactions cannot be neglected. This seems to be the cause why in the case of the stars HD 192103 (WC 7) and HD 192641 (WC 6-7) the calculated intensities of the lines C III λλ 5696 and 8500 differ considerably from the observed ones. The values of the coefficients $\overline{\beta_k\beta_{1k}}$ for the lines C III λλ5696 and 8500 are found demanding that the value of T* obtained from CIII lines be the same as the one found from HeII and CIV lines. The stratification of C ions in the envelopes of these two stars was analysed. The abundance of C seems to be high. It was found that the ratio n(C)/n(He) is 0.66 for HD 192103 and 1.01 for HD 192641. (auth)

26670 FORMATION OF ELEMENTS IN NEUTRON RICH EJECTED MATTER OF SUPERNOVAE. II. Dynamical Gamma-Process Stage. Sato, K. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 51: No. 3, 726-744(Mar 1974).

Thermal and chemical properties of neutron-rich matter ejected by supernova explosion are investigated along the lines of a previous work of the author. In this investigation, the dynamical r-process is worked out for the first time by taking into account a thermodynamical equation. Computations are carried out for a number of sets of expansion speeds and initial n/p ratios at high temperature, and for two extreme cases on fission cutoff, i.e., the pessimistic and optimistic cases on the synthesis of superheavy nuclei. By this investigation the following results are obtained. 1) The energy release accompanied with beta decay and fission is indispensable in reproducing the observed abundance of the r-process elements. 2) The abundance of the r-process products is almost independent of the initial n/p ratio, but depends on the expansion speed of the supernova. To reproduce the r-process peaks of observed abundances the expansion speed of supernova should be greater than the free fall speed but smaller than thirty times the free fall speed. (auth)

26671 EFFECT OF CONVECTION ON THE STABILITY OF NONRADIAL OSCILLATIONS OF STARS. Gabriel, M.; Scuflaire, R.; Noels, A.; Boury, A. (Univ., Liege). Bull. Cl. Sci., Acad. Roy. Belg.; 60: No. 5, 866-887(Jul 1974). (In French).

The coupling between convection and nonradial oscillations is discussed. The limitation of the theory comes from the lack of a good theory for turbulent convection which implies the use of an approximation equivalent to the Böhm–Vitense theory. In the frame of this approximation an expression which gives the influence of convection on the stability of stellar oscillations is deduced. The result is briefly discussed and compared with previous works. (auth)

26672 NOVYE I SVERKHNOVYE ZVEZDY. (Novae and Supernovae). Pskovskii, Yu. P. Moscow; Izdatel'stvo Nauka (1974). 205p.

This book acquaints the reader with objects that occupy a special place in the stellar regions —novae and supernovae. Study of these objects leads to a concept of the origin and development of stars and galaxies. The reader will find much of interest concerning novae and supernovae, in particular the fact that after explosion of supernovae there remain pulsars and radio-wave emitting nebulae, which in turn give rise to cosmic rays and x rays and are the site of formation of interstellar dusts and gases. The book is designed for readers interested in astronomy. (tr-auth)

26673 KINEMATICS AND AGE OF STARS. Mayor, M. (Geneva Observatory). Astron. Astrophys.; 32: No. 3, 321-327 (May 1974).

From a sample of 1010 A and F stars with uvby photometry, the space velocity, age, and metallicity were computed and the relationship between kinematics and age was studied. Furthermore, it is shown that it is not justifiable to include stellar subpopulations whose velocity dispersions are too low in calculations of the tangential component of the solar motion. A new value for the solar motion is proposed (−10, 6, 6) km/s. A value for the galactic disk gradient is deduced from the asymmetric drift: $\partial \ln \sigma / \partial \overline{\omega} = -0.45$. In this computation a variation of the velocity dispersion with distance from the galactic center was included. Finally the kinematic-age relations obtained are used to estimate the variation of calcium re-emission with age. (auth)

26674 SHORT-LIVED FLARE ACTIVITY OF THE HYADES FLARE STAR H II 2411. Rodono, M. (Univ., Messina, Italy). Astron. Astrophys.; 32: No. 3, 337-341(May 1974).

High-speed photometry of the Hyades flare star H II 2411 has shown that its flare frequency is even greater than those of many UV Cet-type stars. Moreover, high-frequency oscillations with flare-like light curve have been detected during a rather intense flare. These observations could validate Gurzadian's (1970) suggestion about the evolution of flare activity with star age from a permanent phenomenon to a sporadic one. (auth)

26675 REMARKABLE OBJECT M 2 TO 9. van den Bergh, S. (Univ. of Toronto). Astron. Astrophys.; 32: No. 3, 351-352(May 1974).

The peculiar nebula M 2−9 is found to exhibit brightness changes on a timescale $< 1 \times 10^8$ s. (auth)

26676 SECULAR STABILITY OF MODELS WITH AN ISOTHERMAL CORE. Gabriel, M. (Univ., Liege). Astron. Astrophys.; 32: No. 3, 309-315(May 1974).

The secular stability of models with an isothermal core is discussed. The determinant of secular stability for $\sigma = 0$ is related to quantities defined as far as possible at the surface of the core and at the bottom of the envelope. This relation is used to discuss the validity of 2 intuitive criteria for secular stability. (auth)

26677 γ-RAY LINES FROM ACCRETING NEUTRON STARS. Reina, C. (Univ., Milan); Treves, A.; Tarenghi, M. Astron. Astrophys.; 32: No. 3, 317-320(May 1974).

The gravitational energy of an ion at the surface of a neutron star is ~100 MeV/n. Therefore infalling ions may induce nuclear reactions in the external layer of the star. The γ-ray line emission produced by this process in accreting x-ray sources is evaluated in terms of the x-ray flux, assuming that the infalling matter and the stellar atmosphere have universal abundances. It is found that the most important reactions are inelastic scattering p, He and symmetrically α, H. These interactions lead to two processes yielding γ-rays, a) neutron production and capture by ambient hydrogen with emission of 2.2 MeV photons, b) direct helium excitation giving 22.5 MeV γ rays. Pair production by these photons and consequent positron annihilation is the most important source of the 0.511 MeV line. If Sco X-1 were an accreting neutron star the intensities of the lines would be $I_\gamma(2.2\ \text{MeV}) \approx 2 \times 10^{-6}$, $I_\gamma(22.5\ \text{MeV}) \approx 8 \times 10^{-7}$, and $I_\gamma(0.511\ \text{MeV}) \approx 10^{-7}$ ph/cm²s. (auth)

26678 ENHANCEMENT OF ULTRAVIOLET LINE OPACITIES IN THE ATMOSPHERES OF PECULIAR A STARS. Leckrone, D. S.; Fowler, J. W.; Adelman, S. J. (Goddard Space Flight Center, Greenbelt, MD). Astron. Astrophys.; 32: No. 3, 237-244 (May 1974).

In the investigation of the photometric properties of Ap stars, as observed both by OAO−2 in the ultraviolet and by ground-based instruments, line-blanketed model atmospheres in the effective temperature range 11,000° to 15,000°K were calculated in which metal line opacities are arbitrarily enhanced by various factors. The enhanced opacity atmospheres predict flux distributions qualitatively similar to those observed for Ap stars from the vacuum ultraviolet through the visible. Longward of 3500 Å they resemble normal line-blanketed model atmospheres with hotter effective temperatures. In the ultraviolet they are flux deficient and possess flux distributions which roughly mimic in shape those of cooler normal atmospheres. Variations of computed emergent flux at various wavelengths as a function of metal line opacity enhancement factor are similar in nature to the observed photometric variations of Ap stars. The diminution of vacuum ultraviolet flux is accompanied by brightening in the blue-visible while the emergent flux in the vicinity of 3000 Å remains constant. The calculations predict a shift of this "null region" towards shorter wavelengths with increasing effective temperature. The model predictions are also consistent with the observed UBV photometric range correlations for Ap stars. The importance of line absorption by iron peak and rare earth species as a major ultraviolet opacity source in Ap stars is emphasized. (auth)

26679 EQUIVALENT WIDTH DATE FOR α TAU. Van Paradijs, J. (Amsterdam Univ.). Astron. Astrophys., Suppl. Ser.; 18: No. 3, 447-461(Dec 1974).

The equivalent width data for α Tau (K5 III), which have been used in an abundance analysis relative to α Boo (van Paradijs and Meurs, 1974), are presented. (auth)

26680 PHOTOGRAPHIC SEARCH FOR RED STARS IN AQUILA−CYGNUS. Akyol, M. U.; Hidajat, B.; Balazs, L. G.; Voelcker, K. Astron. Astrophys., Suppl. Ser.; 18: No. 3, 427-445(Dec 1974).

Results of a low dispersion objective prism spectral survey of infrared stars in the galactic region $37° \le l^{II} \le 71°$, $-3° \le b^{II} \le +3°$ are presented. The search was carried out down to a limiting magnitude $I_k = 11^m.5$. 492 stars were identified and their B, R_k, I_k magnitudes and further data are cataloged. Correlations between the surface distribution of the infrared objects and the interstellar material and H II regions are briefly discussed. An extremely red star in NGC 6823 is thought to be a highly reddened supergiant star. (auth)

26681 SPACE DENSITY OF FAINT M-STARS IN THE VICINITY OF THE SUN. Joeveer, M. pp 3-17 of Metody zvezdnoi statistiki. Joeveer, M. Tartu; Tartu Astrophysical Observatory (1974). (In Russian).

The mean value and the dispersion of the distribution of the absolute magnitudes for the faint M-stars discovered by Sanduleak are estimated. For the galactic mass density of these stars the value $\rho = 0.017\ m_\odot pc^{-3}$ is obtained. Contrary to Murray and Sanduleak it is concluded that the space density of the faint M-stars is too low for explaining the phenomenon of missing mass near the Sun. (auth)

26682 STRUCTURE OF THE SUBSYSTEM OF LONG-PERIOD CEPHEIDS IN THE GALACTOVERTICAL DIRECTION. Joeveer, M. pp 18-34 of Metody zvezdnoi statistiki. Joeveer, M. Tartu; Tartu Astrophysical Observatory (1974). (In Russian).

The space distribution and motions in the z-direction of the classical Population I Cepheids are studied. For the local galactic dynamical parameter C an estimate C = 80 km/s/kpc is obtained, the respective value of the galactic mass density near the Sun is $0.115\ m_\odot/pc^3$. (auth)

26683 AGES OF DELTA CEPHEI STARS AND THE GALACTIC MASS DENSITY NEAR THE SUN. Joeveer, M. pp 35-49 of Metody zvezdnoi statistiki. Joeveer, M. Tartu; Tartu Astrophysical Observatory (1974). (In Russian).

The dependence of dispersion σ_z of the galactovertical distances of δ Cephei stars on the ages of the stars is discussed. The value 0.05 to 0.075 $m_\odot/pc^3$ for the galactic mass density in the vicinity of the Sun was obtained by adopting Kippenhahn's and Smith's period-age relation and assuming that the stars were formed near their maximum distances from the galactic plane. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 26653.

26684 (N-74-31321) RESULTS OF X-RAY AND OPTICAL MONITORING OF SCO X-1. Mook, D. E.; Messina, R. J.; Hiltner, W. A.; Belian, R.; Conner, J.; Evans, W. D.; Strong, I.; Blanco, V.; Hesser, J.; Kunkel, W. (Dartmouth Coll., Hanover, N. H. (USA)). 1974. 41p. (NASA-CR-139568). NTIS $5.00.

Sco X-1 was monitored at optical and x-ray wavelengths from 1970 April 26 to 1970 May 21. The optical observations were made at six observatories around the world and the x-ray observations were made by the Vela satellites. There was a tendency for the object to show greater variability in x-ray when the object is

optically bright. A discussion of the intensity histograms is presented for both the optical and x-ray observations. No evidence for optical or x-ray periodicity was detected. (auth)

26685 DETERMINATION OF UPPER MASS LIMITS FOR MASSIVE X-RAY BINARIES. Hensberge, G.; van den Heuvel, E. P. J. (Amsterdam Univ. (Netherlands). Astronomical Inst.). Astron. Astrophys.; 33: No. 2, 311-313(Jul 1974).

1 fig.; 20 refs.

Upper mass limits for the visible companions of binary X-ray sources are determined from the observed system parameters. This shows the OB-supergiant components of Cyg X-1 and SMC X-1 to be less massive than about 25 M and 21 M, respectively. (auth)

26686 GAMMA-RAY LINES FROM ACCRETING NEUTRON STARS. Reina, C.; Treves, A.; Tarenghi, M. (Milan Univ. (Italy). Istituto di Fisica; Pavia Unit. (Italy). Istituto di Fisica Consiglio Nazionale delle Ricerche, Milan (Italy). Lab. di Fisica Cosmica e Tecnologie Relative). Astron. Astrophys.; 32: No. 3, 317-320(1974).

2 figs.; 1 tab.; 16 refs.

The gravitational energy of an ion at the surface of neutron star is approximately 100 MeV/nucl. Therefore, infalling ions may induce nuclear reactions in the external layer of the star. The γ-ray line emission produced by this process in accreting X-ray sources is evaluated in terms of the X-ray flux, assuming that the infalling matter and the stellar atmosphere have universal abundances. It is found that the most important reactions are inelastic scattering p, He and symmetrically α, H. These interactions lead to two processes yielding γ-rays, neutron production and capture by ambient hydrogen with emission of 2.2 MeV photons, and direct helium excitation giving 22.5-MeV γ-rays. Pair production by these photons and consequent positron annihilation is the most important source of the 0.511-MeV line. (GE)

26687 VARIABILITY OF THE DISPERSION MEASURE OF THE PULSAR NP 0532. Apparao, K. M. V. (Tata Inst. of Fundamental Research, Bombay (India)). Astrophys. Space Sci.; 31: No. 2, L9-L11(Dec 1974).

It is hypothesized that NP 0532 is seen from the Earth through a filament of high density of the Crab Nebula. The variability of the dispersion measure of the pulsar NP 0532 is explained as due to variation in ionization produced in the filament by varying soft x-ray flux of NP 0532. (auth)

26688 AN ALL-SKY CAMERA BATTERY FOR X-RAY ASTRONOMY. de Jager, C. (The Astronomical Institute, Utrecht, Holland). Astrophys. Space Sci.; 31: No. 2, 417-425(Dec 1974).

The increasing number of interesting variable x-ray sources asks for an instrument for continuously monitoring the brightness of the most important x-ray sources over the whole sky. A system consisting of a set of identical large position-sensitive detectors, mounted on the sides of a polyhedral satellite is described. Each counter is illuminated through a large diaphragm, with binary shadow characteristics. By holographic methods the x-ray image of the observed part of the sky could be derived from the illumination of each detector by multiplex analyzing methods. The satellite should have fairly coarse (half a degree accuracy) three-axial stabilization, and an on-board computer-steered data accumulation system. A relation is derived between the number of transparent holes in the diaphragm, the total count rate, and the flux of the faintest observable source. It appears that for a diaphragm with a few hundred transparent holes (detector geometrical area $\sim 10^3$ cm^2) an integration time of approximately 6 min is needed in order that sources with a count rate of 0.01 cm^{-2} s^{-1} should still be observable with a confidence limit of 99%. (auth)

26689 26.3-MHz RADIO SOURCE SURVEY. I. THE ABSOLUTE FLUX SCALE. Viner, M.R. (University of Maryland, College Park, Maryland 20742). Astron. J. 80: No. 2, 83-92 (Feb 1975).

The absolute flux densities of Cyg A, Cas A, Tau A, and Vir A have been measured with an accuracy of about $\pm 5\%$ at 26.3 MHz using a method well suited for use at low radio frequencies where ionospheric scintillation is a limiting factor. No evidence for time variations in any of the four sources has been found. (auth)

26690 THE NATURE OF BL LACERTAE. Baldwin, J.A. (Lick Observatory, University of California, Santa Cruz); Burbidge, E.M.; Robinson†, L.B.; Wampler, E.J. Astrophys. J. Lett. 195: No. 2, L55-159 (15 Jan 1975).

Spectrophotometric measurements of the nebula around BL Lacertae have been made with the Lick image-tube scanner on the 3-m telescope. No absorption features were seen, and, although the nebular spectrum is curved and steeper than that of BL Lac itself, it is not a good match to the energy distribution of a normal elliptical galaxy. Thus we do not confirm the observations by Oke and Gunn in which absorption features were seen corresponding to those in the redshifted spectrum of an elliptical galaxy. We have found no evidence that the nebula around BL Lac is a normal galaxy of stars. (auth)

26691 REDSHIFT DIFFERENCES OF GALAXIES IN NEARBY GROUPS. Harrison, E.R. (Theoretical Studies Group, NASA-Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. Lett. 195: No. 2, L61-L63 (15 Jan 1975).

It is reported that galaxies in nearby groups exhibit anomalous nonvelocity redshifts. In this discussion, (*a*) four classes of nearby groups of galaxies are analyzed, and no significant nonvelocity redshift effect is found; and (*b*) it is pointed out that transverse velocities (i.e., velocities transverse to the line of sight of the main galaxy, or center of mass) contribute components to the redshift measurements of companion galaxies. The redshifts of galaxies in nearby groups of appreciable angular size are considerably affected by these velocity projection effects. The transverse velocity contributions average out in rich, isotropic groups, and also in large samples of irregular groups of low membership, as in the four classes referred to in (*a*), but can introduce apparent discrepancies in small samples (as studied by Arp) of nearby groups of low membership. (auth)

26692 PULSAR PSR 1919+21: NOTCHES, DRIFTING SUBPULSES, MICROSTRUCTURE, AND OTHER EMISSION. Cordes, J.M. (Department of Applied Physics and Information Science, University of California, San Diego). Astrophys. J. 195: No. 1, 193-202 (1 Jan 1975).

The radiofrequency dependence of intensity fluctuations of PSR 1919+21 is discussed. An intensity model that includes drifting subpulses and an independent zero- and low-frequency (steady) intensity is shown to be quantitatively consistent with the salient features of fluctuation spectra. Drifting subpulses are modeled as Gaussian envelopes that modulate a random intensity, a representation that permits estimation of the separate drifting subpulse and steady contributions to mean intensity profile. Quantitative evaluation of the model shows that the steady intensity dominates the pulse character above 200 MHz. The results also suggest that microstructure and notches in mean pulse profiles are associated with the drifting subpulses; their absence at 318 MHz may be due to a combination of two effects: (1) the relative weakness of the drifting subpulses at 318 MHz, and (2) the presence of notches, and perhaps microstructure, in the drifting subpulses themselves appears to be frequency dependent. It is suggested that the drifting subpulses and the steady emission originate from different radii in the pulsar magnetosphere. A 0.9-ms upper limit on the interstellar scattering broadening time at 74 MHz is inferred from the observed fractional notch depth. (auth)

26693 OPTICALLY THIN RADIATING SHOCK WAVES AND THE FORMATION OF DENSITY INHOMOGENEITIES. Chevalier, R.A.; Theys, J.C. (Kitt Peak National Observatory). Astrophys. J. 195: No. 1, 53-60 (1 Jan 1975).

It is found that the gas flow behind a perturbed, optically thin, radiating shock front tends to create density clumps. A two-dimensional hydrodynamic code is used to follow the shock created by an explosion. The shock is perturbed by a density fluctuation in the ambient medium. The growth of clumps is greatest near the time when radiative cooling first becomes significant. After a clump has formed, it tends to move ahead of the parent shock front due to its large momemtum. The magnitude of the density enhancement is approximately proportional to the magnitude of the perturbing fluctuation. The results are discussed, with particular attention to the shock fronts in supernova remnants. (auth)

26694 THE SPECTRUM OF OH 471 (0642+44). Carswell, R.F.; Strittmatter, P.A.; Williams, R.E. (Steward Observatory, University of Arizona); Beaver, E.A.; Harms, R. Astrophys. J. 195: No. 2, 269-277 (15 Jan 1975).

Results of image-tube and Digicon spectroscopy of OH 471 (0642+44) are reported. Wavelengths of 89 stronger absorption features in the range 4000-6000 Å are given, and a number of absorption redshift systems are suggested. The lack of radiation shortward of 4000 Å is attributed to Lyman continuum absorption in the gas giving rise to the various absorption-line systems. (auth)

26695 COHERENT CURVATURE RADIATION AND LOW-FREQUENCY VARIABLE RADIO SOURCES. Cocke, W.J.; Pacholczyk, A.G. (Steward Observatory, University of Arizona). Astrophys. J. 195: No. 2, 279-283 (15 Jan 1975).

A model of low-frequency variable radio sources such as 3C 454.3 based on coherent curvature emission by high-energy electrons in the magnetosphere of a spinar is presented and discussed. This model is applicable to sources at cosmological distances and yields inverse Compton fluxes compatible with present observational data. (auth)

26696 DIELECTRONIC RECOMBINATION AND ABUNDANCES NEAR QUASARS. Davidson, K. (Princeton University Observatory). Astrophys. J. 195: No. 2, 285-291 (15 Jan 1975).

Major obstacles to determining certain elemental abundances associated with some quasars are (1) a lack of accurately measured helium line intensities, and (2) uncertainty about the extent to which dielectronic recombination $C^{+3}+e^- \rightarrow C^{+2}$ is suppressed at the relevant gas and radiation densities. Some calculated results are presented in an attempt to reduce the latter obstacle. (auth)

26697 EMISSION FROM SUPERNOVA REMNANTS. I. THERMAL BREMSSTRAHLUNG IN THE SEDOV–TAYLOR PHASE. Straka, W.C.; Lada, C.J. (Department of Astronomy, Boston University). Astrophys. J. 195: No. 2, 563-566 (15 Jan 1975).

Calculations of total emission and isophotal contours due to thermal bremsstrahlung in the Sedov–Taylor phase of a supernova remnant have been carried out for two ages and two initial energies. The maximum surface brightness occurs inside the shock front, with the position of the maximum moving inward at higher frequencies. The thickness of the observed ring also increases with frequency. At radio frequencies, the surface brightness increases with age, but is independent of initial energy. The total brightness, however, is greater for greater initial energy at a given age due to the greater radius. A formula for scaling of the results is given. (auth)

26698 OBSERVATIONS OF PULSAR RADIO EMISSION. I. TOTAL–INTENSITY MEASUREMENTS OF INDIVIDUAL PULSES. Taylor, J.H.; Manchester, R.N.; Huguenin, G.R. (Department of Physics and Astronomy, University of Massachusetts, Amherst). Astrophys. J. 195: No. 2, 513-528 (15 Jan 1975).

The total intensities of individual pulses and subpulses were measured for 16 pulsars by using a multichannel, de–dispersing receiver and the NRAO 300–foot telescope. Some of the data are presented in the form of "longitude–time diagrams" which display the complex patterns of subpulse intensity variations characteristic of most pulsars. Drifting subpulses are observed and analyzed in several of the sources, but a two–dimensional autocorrelation analysis failed to produce evidence of latent drifting behavior in most of the other pulsars. We find that the separation between adjacent subpulses in the "drifting subpulse" sources varies approximately as $\nu^{-0.25}$. Fluctuation statistics are analyzed as a function of pulsar longitude, and cross correlation analyses show that fluctuations observed in different parts of the pulse window are sometimes, but not always, closely related. These results are consistent with a pulsar model in which the radio emission arises from charged–particle bunches streaming along curved field lines above the pulsar magnetic pole. (auth)

26699 AN INVESTIGATION OF THE OPTICAL SPECTRUM OF SCORPIUS X–1. Chesley, D.M. (Department of Physics and Astronomy, Dartmouth College). Astrophys. J. 195: No. 2, 529-533 (15 Jan 1975).

A table of features found in the optical spectrum of Sco X–1 with suggested identifications is presented. Plots of the λλ4640–4650 blend as a function of the brightness of Sco X–1 are displayed. (auth)

26700 RADIO EMISSION FROM THE PECULIAR NEBULA M2–9. Purton, C.R.; Feldman, P.A.; Marsh, K.A. (Centre for Research in Experimental Space Science, and Physics Department, York University, Toronto). Astrophys. J. 195: No. 2, 479-481 (15 Jan 1975).

Observations at a wavelength of 2.8 cm have yielded a flux density of $(45 \pm 7) \times 10^{-29}$ W m^{-2} Hz^{-1} for the nebula M2–9. When combined with the available optical data, this value is found to be surprisingly low and suggests the existence of condensations in the wings of the nebula, together with a dense gaseous core of emission measure $\sim 10^{10}$ cm^{-6} pc. (auth)

26701 OBSERVATIONS OF FORMALDEHYDE TOWARD M17. Lada, C.; Chaisson, E.J. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. 195: No. 2, 367-377 (15 Jan 1975).

Observations of 6–cm H_2CO toward M17 show evidence for a wide, weak line near a radial velocity of 19 km s^{-1}, and a narrow, intense feature at about 24 km s^{-1}. The former, conspicuously associated with a lane of obscuring dust west of the H II region, exhibits a systematic line–width gradient that indicates a collapse of part of the H_2CO cloud near a region of high density and intense molecular emission. Dynamical arguments suggest $M \lesssim 4 \times 10^4 M_\odot$ for the collapsing region, while considerations of optical extinction and H_2CO density imply $M \simeq 8700\, M_\odot$ for the remaining part of the extended dust lane. The 24 km s^{-1} cloud, of relatively low density and mass, is apparently a foreground object. (auth)

26702 VIBRATIONALLY EXCITED SiO: A NEW TYPE OF MASER SOURCE IN THE MILLIMETER WAVELENGTH REGION. Kaifu, N.; Buhl, D. (National Radio Astronomy Observatory); Snyder, L.E. Astrophys. J. 195: No. 2, 359-366 (15 Jan 1975).

The recently discovered strong emission lines at 86.24 GHz (~3.48 mm) from the J=2–1 rotational transmission of SiO in its first excited vibrational state have been found to be a maser source associated with infrared stars. We have detected 12 maser sources, and almost all are late M–type Mira or semiregular variables. Many of the known OH/H_2O/IR sources are also SiO maser sources, and good velocity correlations between SiO and H_2O emission profiles were found. Characteristics of these new SiO maser sources are discussed. (auth)

26703 DISCOVERY OF A PULSAR IN A BINARY SYSTEM. Hulse, R.A.; Taylor, J.H. (Department of Physics and Astronomy, University of Massachusetts, Amherst). Astrophys. J. Lett. 195: No. 2, L51-L53 (15 Jan 1975).

We have detected a pulsar with a pulsation period that varies sytematically between $0^d.058967$ and $0^d.059045$ over a cycle of $0^d.3230$. Approximately 200 independent observations over 5–minute intervals have yielded a well–sampled velocity curve which implies a binary orbit with projected semimajor axis $a_1 \sin i = 1.0\ R_\odot$, eccentricity $e = 0.615$, and mass function $f(m) = 0.13\ M_\odot$. No eclipses are observed. We infer that the unseen companion is a compact object with mass comparable to that of the pulsar. In addition to the obvious potential for determining the masses of the pulsar and its companion, this discovery makes feasible a number of studies involving the physics of compact objects, the astrophysics of close binary systems, and special– and general–relativistic effects. (auth)

26704 350–MICRON MAPPING OF SAGITTARIUS B2. Righini, G.; Simon, M. (Department of Earth and Space Sciences, State University of New York, Stony Brook); Joyce, R.R.; Gezari, D.Y. Astrophys. J. Lett. 195: No. 2, L77-L79 (15 Jan 1975).

We have mapped at 350μ a $15' \times 15'$ region of Sgr B2 with $3'.5$ resolution, and the central $2' \times 3'$ region with $56''$ resolution. The observations show an extended low–surface–brightness region which is coincident with the regions of diffuse 100–μ radio continuum, and molecular line emission, and a bright compact submillimeter source whose intensity distribution is similar to that of the core of the molecular source. The peak brightness temperature in the compact source is 23°K, which together with the gas temperature inferred from the CO observations suggests that the 350–μ optical depth is of order unity in the central $1'$ of the source. (auth)

26705 PULSAR EXTINCTION. Michel, F.C. (Space Physics and Astronomy Department, Rice University). Astrophys. J. Lett. 195: No. 2, L69-L71 (15 Jan 1975).

We show that the plasma from a very slowly rotating pulsar can escape without forcing open the field lines. Our suggestion is that such opening is essential for the radio emission, and hence the consequence for slow pulsars is extinction of the pulsar phenomenon. The critical period is estimated to be about 3 seconds for typical pulsar magnetic moments (10^{29} weber–m), in reasonable agreement with the data, which suggest a cutoff in this vicinity. Such slow "pulsars" nevertheless should continue to emit relativistic particles as long as surface ions (e.g., iron) are available. (auth)

26706 RELATION BETWEEN EMISSION AND ABSORPTION COEFFICIENTS FOR ARBITRARY RADIATION PROCESSES. Oster, L. (Univ., Bonn). Astron. Astrophys.; 33: No. 1, 151-152 (Jun 1974).

A universally applicable rule that allows the computation of absorption from emission coefficients and vice versa is presented and the synchrotron case treated as an example. (auth)

26707 POSSIBLE PERIODIC VARIATIONS IN THE SECONDARY MINIMUM OF HD 153919 = 2U 1700–37. de Freitas Pacheco, J. A. (Univ. Sao Paulo, Brazil); Steiner, J. E.; Quast, G. R. Astron. Astrophys.; 33: No. 1, 131-133(Jun 1974).

UBV photoelectric photometry of HD 153919 performed during southern winter 1973 at ITA Observatory. The comparison of the data with other published data suggests that the secondary minimum of HD 153919 varies with a period of about 32 days. (auth)

26708 RADIO DETECTION OF A COMPACT H II-REGION ASSOCIATED WITH FAR-INFRARED AND MOLECULAR LINE EMISSION IN CYGNUS. Wendker, H. D. (Hamburg Sternwarte); Baars, J. W. M. Astron. Astrophys.; 33: No. 1, 157-159(Jun 1974).

A recently detected source of far-infrared and molecular line radiation in Cygnus has been observed with the Westerbork Synthesis Radio Telescope at 6 and 21 cm wavelength, yielding flux densities of 85 and 67×10^{-29} W m^{-2} Hz^{-1}, respectively, and an angular size of about $3''$. The radio source is found to be a compact H II-region, which could be excited by an early B-type star. No optical object can be seen at its position. (auth)

26709 QSOs OF HIGH REDSHIFT. Browne, I. W. A.; Bentley, M.; Haves, P.; McEwan, N. J.; Spencer, R. E.; Stannard, D. (Nuffield Radio Astronomy, Jodrell Bank, Eng.). Nature (London); 252: No. 5480, 209-210(15 Nov 1974).

It is stated that during a series of observations at Jodrell Bank on the radio structures of a large sample of QSO candidates four steep spectra sources were found having properties suggesting

that they may be QSOs of unusually high redshift. At present no QSOs with steep radio spectra and having redshifts >2.4 appear to be known; all with higher redshifts have flat or concave spectra, but it was considered of interest to determine the properties that QSOs with steep radio spectra and high redshifts might have. They would probably lack a uv excess and are likely to be compact with angular diameters of less than a few arc sec. The observations were made with the Mark II–III radio link interferometer at Jodrell Bank. The four steep spectrum sources were found to be essentially unresolved and showed optical properties expected of high redshift QSOs. It is considered that these four objects are worthy of further spectroscopic investigation. (UK)

26710 CHANGE OF PULSE CHARACTERISTICS OF THE VELA PULSAR WITH FREQUENCY. Komesaroff, M. M. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia); McCulloch, P. M.; Rankin, J. M. Nature (London); 252: No. 5480, 210-212(15 Nov 1974).

It is stated that below 2000 MHz the average pulse profile from the Vela pulsar (PSR 0833-45) shows a single peak with a sharp rise and a more gradual decay. At higher frequencies a broader and more complex pulse is observed, apparently having two distinct components. Observations were made in November 1972 at 1400 and 4830 MHz, using the Parkes telescope, to study this frequency dependence. A single receiver and linearly polarized feed were used at each frequency. Some of the variability must be intrinsic to the pulsar, since the relative amplitude of the two peaks also varied. Attempts were made to ascertain which of the 4830 MHz peaks most nearly coincided with the 1400 MHz pulse, and it appeared that the first did so. It appeared that the 4830 MHz pulse may be represented as the sum of two components, the first being similar to the 1400 MHz pulse. Pulse variability made it very difficult to estimate a meaningful absolute spectral index for frequencies >4830 MHz, although the relative spectral index was more easily estimated. The much flatter spectrum of the second component suggested that a different emission mechanism is involved. Any pulses at frequencies beyond the radio region might be expected to occur at the time of the second component, and in this connection attempts have been made to detect pulsed γ-rays in the 10 to 30 MeV range from the Vela pulsar; it was found that the γ-pulse more nearly coincides with the latter spectrum radio component. (UK)

26711 SEARCH FOR PULSED X RAYS FROM 3U0833-45 (VELA PULSAR). Rappaport, S.; Bradt, H.; Doxsey, R.; Levine, A.; Spada, G. (Massachusetts Inst. of Tech., Cambridge). Nature (London); 251: No. 5475, 471-472(11 Oct 1974).

A search for pulsed x-rays from 3U0833-45 has been carried out. The Uhruru error box for this source (~ 8′ × 24′) contains the Vela pulsar. An upper limit of ~ ½ the intensity of 3U0833-45 for periodic pulsing with the 89-ms period of the Vela pulsar was obtained. Other evidence for x-ray emission from the Vela pulsar is reviewed. (auth)

26712 EFFECT OF PULSAR P0950 SPORADIC NARROW-BAND RADIOEMISSION. Udal'tsov, V. A.; Zlobin, V. N. (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR; 218: No. 4, 803-806(1 Oct 1974). (In Russian).

The rapid variation of the spectra of the 0950 pulsar was studied by simultaneous measurements of the intensities at the frequencies of 83, 95, 99, 103, 107, 108, 109, 110, and 111 MHz. The measurements were made on January 14 and 15 and February 15 and 18, 1972. A complex picture of the variation of the spectra was obtained which can be represented as the result of the total radiation of many "radiolines". The validity of several mechanisms in explaining the spectra obtained is discussed. (JSR)

26713 DISTANCE TO CYGNUS X-1. Cheng, C. C.; Phillips, K. J. H.; Wilson, A. M. (Naval Research Lab., Washington, D.C.). Nature (London); 251: No. 5476, 589-590(18 Oct 1974).

Reference is made to the x-ray object Cygnus X-1 and its optical counterpart HDE226868, which is a highly reddened star of type 09.7 Iab. The O star is a single-lined spectroscopic binary, and assignments for the minimum mass of the secondary, which is considered to be the x-ray object, suggest that the latter is a black hole. Such conclusions, however, are dependent on the mass of the O star being ~ 20 to 30 $M_\odot$, which would be the case if the star were "normal" for its luminosity class; but the possibility of heating of the primary by the nearby x-ray object, and spectroscopic indications of mass loss, indicate that such an assumption is unsafe. In order to determine the mass of HDE226868 a more complete spectroscopic analysis from which the effective temperature and surface gravity can be deduced, and a determination of luminosity, from the distance to the object, are necessary. The distance is crucial to the problem, since if the effective temperature and gravity of the O star are known, the mass will vary as the square of the distance. An error in the distance by a factor of about two means that the models for the x-ray source need not include a black hole. Accurate estimates of the distance to HDE226868 have recently been claimed as 2.5 kpc. Such a large distance favors the black hole model. These estimates were based on the reddening produced by interstellar dust; a consistent distance–reddening relationship was assumed for this region of the sky, but the evidence for this needs examining more closely, particularly in view of the irregularity of reddening in the Cygnus region. It is considered that it is over-optimistic to expect reddening measurements to be able to provide the distance of HDE226868 to the required accuracy, and until there is a far more accurate determination of the distance it seems premature to suggest that the x-ray source is a black hole. (UK)

26714 NEW EXTRAGALACTIC VARIABLE SOURCES FROM AN 8-GHz SURVEY. Brandie, G. W.; Bridle, A. H.; Kesteven, M. J. L. (Queen's Univ., Kingston, Ont.). Nature (London); 252: No. 5480, 212-214(15 Nov 1974).

It is stated that studies of variable extragalactic radio sources have so far been concentrated on sources having "centimeter excess" spectra. Observations are here reported, using the National Radio Astronomy Observatory 300 ft, transit telescope at 2.7 GHz, in which variability was detected in two radio galaxies not having "centimeter excesses". Forty-eight sources in all were examined, and every QSO examined was observed to vary at some frequency. In all, five new variable and two new possibly variable sources were found. It was found that stellar objects tend to be variable on time scales of a few hours, whereas radio galaxies do not. Variability indexes are given. (UK)

26715 CATALOG OF EXTRAGALACTIC RADIOSOURCE IDENTIFICATIONS. Veron, M. P.; Veron, P. (Tel Aviv Univ., Israel). Astron. Astrophys., Suppl. Ser.; 18: No. 3, 309-403 (Dec 1974).

This is a compilation of all published optical identifications of extragalactic radiosources. The catalog contains 4022 entries for 2882 different radio sources published in 232 papers. (auth)

26716 H 90α RADIO RECOMBINATION LINE OBSERVATIONS OF RCW 38. Huchtmeier, W. K. (CSIRO, Sydney). Astron. Astrophys.; 32: No. 3, 335-336(May 1974).

The H 90α radio recombination line was observed at a grid of nine points over the H II region RCW 38. A gradient in radial velocity over the source was found, which probably indicates expansional motions. (auth)

26717 IR-EXCESS RADIATION AND THE ABSORPTION CHARACTERISTICS OF DUST IN GALACTIC H II REGIONS. Mezger, P. G.; Smith, L. F.; Churchwell, E. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 32: No. 3, 269-282(May 1974).

The ir-excess of H II regions, i.e. the ir radiation in excess of that expected from heating by trapped Lyman alpha photons alone, is derived as a function of the absorption cross sections of dust grains and the radiation spectrum of the associated star cluster in the wavelength ranges $228 < \lambda < 504$ Å, $504 < \lambda < 912$ Å and $\lambda > 912$ Å. Comparison with observations indicates that the effective absorption cross section of the dust grains between 912 and 504 Å is about 0.24 times the extinction cross section in the visual; the effective absorption cross section shortward of 504 Å is about 1.71 times the extinction cross section in the visual. The photons between 228 and 504 Å are the most important for heating the dust in most galactic H II regions; this accounts for the observed correlation between the ir-excess and the He^+-abundance, and also the smaller sizes of the ir sources compared to their radio counterparts. The low absorption cross section in the range 1500 to 912 Å allows much of the stellar radiation to escape and heat the dust around the H II region. When the density of the H II region is very high, the plasma becomes optically thick to the radio continuum radiation, decreasing the observed radio flux. Also, dust absorption greatly reduces the size of the H II region. Thus, regions with $n_e \gg 10^5$ cm^{-3} are predicted to be strong ir emitters but very weak radio sources. (auth)

Solar Phenomena

Refer also to abstracts 26602, 26607, 26680–26682, 26871, 26888, and 26894.

26718 (AD-787720) RESEARCHES IN THE FIELD OF VARIABLE SOLAR PHENOMENA. Interim Scientific Report, 1 Feb 1972–31 Jan 1973. Jensen, E.; Elgaroy, O. (SEE CODE-3259120 Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). 30 Mar 1973. 13p. (AFCRL-TR-74-0421). NTIS $3.25.

Observations of solar radio noise were made at the Oslo Solar Observatory. A radiometer operating at 225 MHz and a new high-resolution radio spectrographs operating in the band 500 to 550 MHz were used, in addition to other spectrographs working in the 150 to 175 MHz and 310 to 340 MHz bands. Data obtained on the fine structure of solar radio noise bursts provide new insights on source mechanisms in the solar atmosphere and the effects of the solar magnetic field. Work on isotope ratios for several elements in the sun is briefly reviewed. (GRA)

26719 (AD-787721) RESEARCHES IN THE FIELD OF VARIABLE SOLAR PHENOMENA. Interim Scientific Report, 1 Feb 1972-31 Jan 1974. Jensen, E.; Elgaroy, O. (SEE CODE-3259120 Oslo Univ. (Norway). Institutt foe Teoretisk Astrofysikk). 25 Mar 1974. 17p. (AFCRL-TR-74-0422). NTIS $3.25.

Studies concerning spectra and positions of fastdrift bursts, fine structure at decimeter wavelengths, and intermediate drift bursts are outlined. Also discussed are studies of the solar abundances of chemical elements, solar bismuth content, and solar abundance of boron. A theory of quiescent prominences and the physical properties of prominences is covered. (GRA)

26720 (CEA-R-4654) MEASUREMENT OF THE COSMIC RAYS INTENSITY IN THE INTERPLANETARY SPACE ABOARD HEOS SATELLITE, YEARS 1969-1972. Barouch, E.; Gros, M.; Masse, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Div. de la Physique). Feb 1975. 75p. (In French). Dep. NTIS (US Sales Only) $7.00.

The S 72 experiment, aboard the HEOS A1 satellite from the European Spatial Research Organization (E. S. R. O.) was designed to study the cosmic-ray flux in interplanetary space, mainly solar-flares particles. The time behavior of the proton intensity in several energy windows during the years 1969 to 1972 is shown. This time interval, corresponding to the decrease of the solar cycle, allowed to record 85 significant solar flares. (auth)

26721 (N-74-29234) RESEARCH IN PARTICLES AND FIELDS. Semiannual Status Report, 1 October 1973-31 March 1974. Vogt, R. E. (California Inst. of Tech., Pasadena (USA)). 31 Mar 1974. 24p. (NASA-CR-38843). NTIS $4.25.

Investigations, by particle-detectors flown on spacecraft, of the astrophysical aspects of cosmic radiation and the radiation environment of the Earth are reported along with the research of the interplanetary medium and planetary magnetic fields. The cosmic-ray interactions with the interplanetary and interstellar medium, and radio scintillation theory were also studied. (STAR)

26722 (N-74-30257) INVESTIGATION OF THE STRUCTURE AND COMPOSITION OF THE SOLAR ATMOSPHERE USING X-RAY AND EUV SPECTRA OBTAINED WITH THE OV1-17 AND OSO-4 AND OSO-5 SATELLITES. Semiannual Status Report, 1 January-30 June 1974. Walker, A. B. C. Jr. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Jul 1974. 50p. (NASA-CR-138944; SASR-1). NTIS $5.50.

Studies of the structure and composition of the solar corona were undertaken, using a number of satellite observations of the coronal x-ray spectrum. A systematic technique was developed to carry out the required analysis, and the analytical techniques available to calculate the coronal spectrum have been developed and improved. A review of other analyses of solar coronal structure is also included. (auth)

26723 (N-74-32239) NUMERICAL CALCULATION OF OUTWARD PROPAGATION OF SOLAR DISTURBANCES. Final Report. Wu, S. T. (Alabama Univ., Huntsville (USA). School of Graduate Studies and Research). Feb 1974. Contract NAS8-25101. 88p. (NASA-CR-120368; UAH-RR-151). NTIS $7.50.

The responses of the solar atmosphere due to an outward propagation shock are examined by employing the Lax-Wendroff method to solve the set of nonlinear partial differential equations in the model of the solar atmosphere. It is found that this theoretical model can be used to explain the solar phenomena of surge and spray. A criterion to discriminate the surge and spray is established and detailed information concerning the density, velocity, and temperature distribution with respect to the height and time is presented. The complete computer program is also included. (auth)

26724 STUDIES OF SOLAR MAGNETIC FIELDS. III. The East-West Orientation of Field Lines. Howard, R. (Hale Observatories, Pasadena, Calif. (USA)). Solar Phys.; 39: No. 2, 275-287(Dec 1974).

Solar magnetic flux data accumulated from the magnetograph of the Mount Wilson Observatory are used to infer average east-west field inclination angles for the interval 1967-1973. In all latitude zones the total flux ($|F^+| + |F^-|$) measurements indicate that the field is inclined so as to trail the rotation by a small amount. Averaged over the whole disk, this angle is 0.8°. No clear pattern may be seen in the variations of this quantity with time in any latitude zone. The individual polarities show some systematic behavior. In the north, the negative (preceding) fields are inclined so as to trail the rotation at all latitudes. The positive fields are inclined toward the rotation by a smaller amount. In the south, a similar situation exists for the fields below 40° latitude, but poleward of 40° the following polarity fields are strongly inclined to trail the rotation. In the north, there has been a gradual decrease of the inclination angles of both polarities during the seven-year interval. At the higher latitudes the sign of the east-west inclinations actually changed during the interval. From an examination of magnetograms it is clear that there are no systematic east-west inclinations of field lines outside sunspots greater than about 30° from the vertical. Cross correlations of the east-west inclination data indicate that equatorward of 40° variations in time of the orientation of fields of the two polarities tend to be parallel, and poleward of 40° these variations are such that the two polarities incline toward or away from each other. (auth)

26725 DETECTION OF SMALL SCALE STRUCTURE IN METAL LINES AT THE EXTREME SOLAR LIMB. Livingston, W. C. (Kitt Peak National Observatory, Tucson, Ariz. (USA)); White, O. R. (High Altitude Observatory, Boulder, Colo. (USA)). Solar Phys.; 39: No. 2, 289-295(Dec 1974).

A tangential limb spectrum at 5870 Å is described which geometrically probes the high photosphere through the low chromosphere. Velocity and brightness structures with sizes ranging from 500 to 1500 km are present in the stronger emission lines. Such structure is consistent between the Fe I and Ba II lines, and emission knots in these lines coincide with continuum bright streaks. But no correlation is evident between structure in the He I D_3 line, emission in the Na I D_2 line, and emission in the Fe I and Ba II lines as a group. Two classes of near-horizontal velocity structure are seen in the height range from 0 to 500 km above the limb: $v \gtrsim 1$ km s^{-1} for the weaker metals and $v \sim 7$-10 km s^{-1} for the Na I line. Differences in line opacity are suggested as the cause of the low correlation between the fine structure in the various lines. (auth)

26726 WHITE LIGHT NETWORK IN THE SOLAR PHOTOSPHERE. Liu, S. Y. (Hale Observatories, Pasadena, Calif. (USA)). Solar Phys.; 39: No. 2, 297-300(Dec 1974).

Time-averaging technique is performed on a set of white light pictures obtained at $\mu = 0.87$. After eliminating short-lived granulations, the time-averaged pictures show some large scale but longlived brightness patterns which are not recognizable in any of the single frame snapshots. The patterns are brighter than the background and are co-spatial with the upper photospheric emissions and magnetic fields. These patterns are defined as the white light network. (auth)

26727 MAGNETIC PUKAS AND THE LIFETIME OF THE SUPERGRANULATION. Livingston, W. C.; Orrall, F. Q. (High Altitude Observatory, Boulder, Colo. (USA)). Solar Phys.; 39: No. 2, 301-304(Dec 1974).

There are photospheric regions of the size of coarse network cells, that remain free of photospheric magnetic flux for several days, even though completely surrounded by magnetic flux. The examples noted so far have all appeared within active regions where they are easily visible on magnetograms because of their contrast with the surrounding distribution of field. Some of these regions are so striking that they appear as holes in the surrounding active region. For this they are referred to as "magnetic pukas" (a puka being the Hawaiian word for a hole that goes all the way through). It is suggested that these magnetic pukas are produced by supergranular convective cells with lifetimes much longer than the usual coarse network lifetime of 21 to 25 h. (auth).

26728 COMPUTATION OF OSCILLATOR STRENGTHS BY A SEMIEMPIRICAL METHOD FOR SOME ELEMENTS OF THE IRON GROUP AND THEIR SOLAR PHOTOSPHERIC ABUNDANCE. II. Results for Sc I. Biemont, E. (Liege Univ. (Belgium). Inst. d'Astrophysique). Solar Phys.; 39: No. 2, 305-308(Dec 1974).

Absolute oscillator strengths are computed by the STF method for selected lines of ScI. The lifetimes deduced from these values are in satisfactory agreement with recent beam-foil measurements. From a study of 10 selected lines, a new value of the solar photospheric abundance is derived ($\log N_{Sc} = 3.04$) in agreement with the meteoritic value. (auth)

26729 A METHOD FOR INVESTIGATING THE BRIGHTNESS DISTRIBUTION NEAR THE SOLAR LIMB AT MILLIMETER WAVELENGTHS. Joensen, P.; McCutcheon, W. H.; Shuter, W. L. H. (British Columbia Univ., Vancouver (Canada). Dept. of Physics). Solar Phys.; 39: No. 2, 309-314(Dec 1974).

The brightness distribution near the solar limb has been investigated by means of a technique in which derivatives of drift scans of the Sun were compared with derivatives of drift scans of the Moon. The results obtained at 88.3 GHz (3.4 mm) indicate that the Sun is limb neutral within the uncertainty of the measurement. If limb brightening or darkening is present, it represents less than 1.6% or 1.2%, respectively, of the total power received from the Sun at this wavelength. (auth)

26730 SOLAR LIMB BRIGHTENING AT MILLIMETER WAVELENGTHS. Kalaghan, P. M. (Air Force Cambridge Research Labs., Bedford, Mass. (USA)). Solar Phys.; 39: No. 2, 315-322 (Dec 1974).

The radio brightness distributions at λ9 mm, λ3.5 mm, and λ1.2 mm is calculated employing a statistical technique to account for the presence of spicules randomly occurring along the ray path. The results indicate limb brightening at each wavelength when the Avery and House (1969) spicule model is employed. This contradicts the results of Lantos and Kundu (1972) whose method of computation is shown to be inadequate. (auth)

26731 HIGH-RESOLUTION PHOTOGRAPHY OF THE SOLAR CHROMOSPHERE. XV. Preliminary Observations in Fe I Lambda 6569.2. Bray, R. J.; Loughhead, R. E.; Tappere, E. J. (National Measurement Lab., Sydney (Australia)). Solar Phys.; 39: No. 2, 323-326(Dec 1974).

High-quality photographs of the quiet and enhanced network have been obtained at the centre of Fe I λ6569.2 and in the nearby continuum, using a ⅛ Å filter. In agreement with Dunn and Zirker, the photospheric granules are noticeably smeared in the neighbourhood of the enhanced network. Nevertheless, many of the bright network elements are co-spatial with individual (smeared) photospheric granules. The photospheric granulation fails to appear at the centre of the Fe line, suggesting that the top of the convection zone is located below the temperature minimum. (auth)

26732 RADIATION LOSS AND MECHANICAL HEATING IN THE SOLAR CHROMOSPHERE. Ulmschneider, P. (Wuerzburg Univ. (F. R. Germany)). Solar Phys.; 39: No. 2, 327-336(Dec 1974).

The radiation loss of the solar chromosphere is evaluated on the basis of the Harvard Smithsonian Reference Atmosphere. The total radiative flux is found to be between 2.5 and 3.3 E6 erg cm^{-2} s^{-1}. A discussion of possible heating mechanisms shows that the short period acoustic wave theory is the only one able to balance the chromospheric radiation loss and is consistent with observation. (auth)

26733 SOLAR PROMINENCES IN THE EXTREME ULTRAVIOLET AS OBSERVED FROM THE APOLLO TELESCOPE MOUNT. Schmahl, E. J.; Foukal, P. V.; Huber, M. C. E.; Noyes, R. W.; Reeves, E. M.; Timothy, J. G.; Vernazza, J. E.; Withbroe, G. L. (Center for Astrophysics, Cambridge, Mass., U. S. A.). Solar Phys.; 39: No. 2, 337-347(Dec 1974).

Observations of quiescent solar prominences with the Harvard College Observatory spectrometer aboard Skylab show that prominence material is optically thick in the Lyman alpha line and the Lyman continuum. The color temperature of the Lyman continuum has a mean of 6600°K and an upward gradient toward the top of the prominence. The departure coefficient of the ground state of hydrogen is found to be of the order of unity as expected from theory. The optical depth of the CIII sheath region is determined directly from the observation of the limb through the prominence and used to infer the mean electron density and the temperature gradient of the sheath. The result implies that the sheath density is about 0.4, and the temperature gradient about 1.4 times the respective value in the CIII transition zone of the quiet Sun. The CIII triplet-singlet ratio for the prominence is found to give a density compatible, within the uncertainty of the atomic parameters, with the density obtained from the optical depth. The OVI λ 1032 line, which is emitted by both the prominence and the surrounding corona, is used to obtain an estimate of the thickness of the outer transition sheath of the prominence. (auth)

26734 ON THE INTENSITY OF HELIUM AND HYDROGEN LINES IN THE QUIESCENT PROMINENCES WITH FILAMENTARY STRUCTURE. Moroshenko, N. N. (AN Ukrainskoj SSR, Kiev). Solar Phys.; 39: No. 2, 349-362(Dec 1974).

Diffuse penetration of ionizing radiation into prominences with filamentary structure is considered. The equations of radiative transfer, ionization balance and steady state of the triplet system of the helium atom (with 27 levels and continuum) are solved for a chosen model of prominences. The calculated intensity ratios of helium and hydrogen lines for prominences of various brightness are compared with observations. Parameters of filamentary structure of prominences which are in good agreement with observations are given. (auth)

26735 TWO-DIMENSIONAL SPATIAL POWER SPECTRA OF PHOTOSPHERIC VELOCITY FLUCTUATIONS. Teske, R. G. (San Fernando Observatory, Aerospace Corporation, California, U. S. A.). Solar Phys.; 39: No. 2, 363-375(Dec 1974).

Two-dimensional spatial autocorrelation functions and power spectral density distributions were obtained from high-resolution velocity spectroheliograms. Although the autocorrelation functions indicate the existence of velocity cells of size roughly 2500 to 3500 km, the power spectra fail to reveal them because the cells are not strictly spatially periodic. (auth)

26736 DIGITAL ENHANCEMENT OF SOLAR X-RAY SPACE PHOTOGRAPHY. Chiralo, R. P. (Aerospace Corp., Los Angeles, Calif. (USA)). Solar Phys.; 39: No. 2, 377-386(Dec 1974).

Digital enhancement techniques are applied to digitized solar x-ray photography. Two-dimensional Fourier filtering, intensity thresholding, and histogram equalization techniques are described, and their effects on the x-ray image are compared and analyzed. Possible applications of these digital techniques to solar photography interpretation are suggested. (auth)

26737 ON 94 A CORONAL LINE OBSERVATIONS. Tetruashvili, E. I. (Abastumani Astrophysical Observatory, Georgia, U.S.S.R.). Solar Phys.; 39: No. 2, 387-391(Dec 1974).

Coronal yellow line emission was observed by the Lyot coronagraph at the Abastumani Astrophysical Observatory. Line intensity is $I = 45$ erg cm^{-2} s^{-1} sr^{-1} $Å^{-1}$, its half-width $\Delta\lambda = 1.3$ Å, electron concentration $n_e = 7.5 \times 10^8$ cm^{-3}. (auth)

26738 EQUILIBRIUM AND STABILITY OF FORCE-FREE MAGNETIC FIELD. Molodensky, M. M. (AN SSSR, Moscow. Inst. Zemnogo Magnetizma, Ionosfery i Rasprostraneniya Radiovoln). Solar Phys.; 39: No. 2, 393-404(Dec 1974).

Force-free magnetic fields (f.f.f) are considered as the first approximation of magnetic hydrodynamic equations in the case when the energy of the field exceeds the thermal energy of the medium. Such a relation of energies takes place in the upper atmosphere of the Sun in active regions. The consequence of the virial theorem obtained shows that for any solution of the corresponding nonlinear system of equations only two cases are possible: either the total energy of the field is given by a divergent integral, or in some regions the force-free character of the field is destroyed. This permits the conclusion that it is impossible to build f.f. current systems everywhere, and therefore "boundary" problems for this type of fields are of the same importance as for harmonic fields. Integral relations are obtained which are the necessary conditions for the solution of boundary problems. According to the classical principle of Thompson the harmonic fields are always stable, while f.f.f. may be stable or unstable. It is shown that: (1) arbitrary f.f.f. are stable to small changes of boundary conditions; (2) among f.f.f. the hydrodynamically stable configurations exist. The hydrodynamic stability condition restricts the size of force-free currents in such configurations. (auth)

26739 A COMMENT ON THE DETECTION OF CLOSED MAGNETIC STRUCTURES IN THE SOLAR WIND. Gosling, J. T. (High Altitude Observatory, Boulder, Colo. (USA)); Roelof, E. C. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA)). Solar Phys.; 39: No. 2, 405-408(Dec 1974).

It has recently been suggested that the large-scale structure of the interplanetary magnetic field can be deduced solely from solar-wind speed measurements. Here it is emphasized that, in addition to speed measurements, direct measurements, of the interplanetary field and indirect diagnostics such as measurements of the solar-wind kinetic temperature and galactic and solar energetic particle modulations and anisotropics are required to distinguish between open and closed magnetic structures in the solar wind. (auth)

26740 VISUAL AND PHOTOGRAPHIC WHITE LIGHT FLARE OBSERVATIONS OF 4 July 1974. Feibelman, W. A. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Solar Phys.; 39: No. 2, 409-413 (Dec 1974).

Visual impressions and a photograph of an intense white-light flare are presented. A densitometer trace across the 4 July 1974 flare showing relative intensity of the white-light flare, photosphere, and umbra is also shown. A second white light flare is suspected on a photograph taken 4.75 hrs later. Both flares coincide in time with major Hα-flare activity. (auth)

26741 ON THE LOW-TEMPERATURE REGION OF CHROMOSPHERIC FLARES. Somov, B. V.; Syrovatskii, S. I. (AN SSSR, Moscow. Fizicheskij Inst.). Solar Phys.; 39: No. 2, 415-430 (Dec 1974).

Most of the energy of particles accelerated in a flare is used for the creation of a high-temperature flare region, the structure of which is determined by the heat conduction (Shmeleva and

Syrovatskii, 1973). However, as the temperature drops with the depth in the chromosphere, the heat flux decreases quickly and in the low-temperature part of a flare may appear to be lower than the direct energy flux carried to these depths by the most energetic of the accelerated particles. In the latter case the radiation from the low-temperature region will be determined by the direct input of energy by energetic particles (Hudson, 1972; Brown 1973). Conditions are considered under which one of the above-mentioned types of heating dominates. Two types of flares are considered: penetrating flares, when heating is produced by nonthermal particles, and thermal ones, when the heat conduction dominates. The conditions of occurrence of one of these types depend mainly on the particle energy spectrum: the heat conduction dominates for the soft spectra and for the high enough temperature of the hot (coronal) part of a flare, as is usual for x-ray flares. It is essential that for both the heating mechanisms the radiation from the low-temperature regions gives as a rule only a small part of the total flare radiation. In the case of conductive heating the temperature run in the cold part of a flare depends essentially on the mode of hydrogen ionization in this region. It is shown that the optical depth effects in hydrogen ionization can be neglected for flares in the upper chromosphere with unperturbed temperature $T \simeq 10{,}000°K$. The absorption of radiation begins to play a role for lower boundary temperatures $T = 6000$ to $8000°K$. (auth)

26742 BEHAVIOR OF THE FLARE-PRODUCED CORONAL MHD WAVEFRONT AND THE OCCURRENCE OF TYPE II RADIO BURSTS. Uchida, Y. (Tokyo Univ., Mitaka (Japan). Tokyo Astronomical Observatory). Solar Phys.; 39: No. 2, 431-449(Dec 1974).

The propagation of the weak MHD fast-mode shock emitted into the corona by flares at their explosive phase is computer-simulated. It is shown as the result that the shock wave is refracted towards the low Alfvén velocity regions pre-existing in the corona, and the strength of the shock, which is otherwise weak, is drastically enhanced on encountering low-V_A regions due to the focussing effect by refraction and also due to the lowered propagation velocity of the shock in such regions. It is expected that electron acceleration takes place in such a drastic strengthening of the shock, leading to the local excitation of plasma waves and eventually to the occurrence of radio bursts at such locations. Such locations of shock strength enhancement, when computed by using HAO realistic models of coronal density and magnetic field of the day of certain Type II burst events, actually coincide roughly with the observed positions of Type II bursts. Peculiar configurations of Type II burst sources as well as their occurrence even beyond the horizon of the responsible flare are explained consistently by the large scale refraction and the local enhancement of the shock due to the global and local distribution of Alfvén velocity in the corona. A unified interpretation is given for the occurrence of Type II bursts and Moreton's wave phenomena, and also the relation of the MHD fast-mode disturbance with other flare-associated dynamical phenomena is discussed. (auth)

26743 HARMONIC RATIOS OF INVERTED-U TYPE III BURSTS. Stewart, R. T. (Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Radiophysics). Solar Phys.; 39: No. 2, 451-458(Dec 1974).

The harmonic ratios of a large sample of inverted-U bursts are found to be smaller at the turning frequency than at the starting frequency. Ratios < 2.0 are explained by postulating that the lowest fundamental frequencies emitted are prevented from escaping from the corona by an evanescent region between the source and the observer. This concept is used to construct a source model for inverted-U bursts where the density is lower inside a magnetic flux tube than it is outside. (auth)

26744 INTENSITIES AND ANISOTROPIES OF LOW ENERGY SOLAR PROTONS MEASURED ABOARD THE SATELLITES AZUR, EXPLORER 35 AND 41, NOVEMBER 1969–APRIL 1970. Kirsch, E.; Muench, J. W. (Max-Planck-Institut fuer Aeronomie, Lindau; Harz (F. R. Germany)). Solar Phys.; 39: No. 2, 459-478(Dec 1974).

Solar proton fluxes observed with the satellites Azur, Explorer 41, and Explorer 35 as well as interplanetary magnetic field measurements obtained by Explorer 35 are used to study the transport processes of low energy protons. The experimental results are compared with several authors' theories. The influence of diffusion, convection, collimated convection, and scatter-free propagation is discussed as well as propagation close to the Sun. In most cases the anisotropy vectors are field aligned during the rise and decay phase of the events. However, large scale directional discontinuities of the interplanetary magnetic field can decouple the anisotropy vectors from the field directions and determine the phases in which collimated convection and convection with the solar wind dominates. Three extreme western limb events give evidence for propagation of solar protons close to the Sun and anisotropic diffusion in the interplanetary space. (auth)

26745 SOLAR COSMIC RAY COMPOSITION ABOVE 10 MeV/NUCLEON AND ITS ENERGY DEPENDENCE IN THE 4 AUGUST 1972 EVENT. Bertsch, D. L.; Biswas, S.; Reames, D. V. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Solar Phys.; 39: No. 2, 479-491(Dec 1974).

Observations of the proton, helium (C,N,O), and Fe-group nuclei fluxes made during the large 4 August 1972 solar particle event are presented. The results show a small, but significant variation of the composition of multiple-charged nuclei as a function of energy in the energy region above 10 MeV/n. In particular, the He/(C,N,O) abundance ratio varies by a factor ~ 2 between 10 and 50 MeV/n and the Fe-group/(C,N,O) ratio suggests a similar variation. Abundance ratios from the 4 August 1972 event are compared as a function of energy with ratios measured in other solar events to show that several of the earlier results are consistent with an energy variation like that observed in August 1972, while certain other events must have had a substantially different dependence of composition on energy. At energies $\gtrsim 50$ MeV/n, the He/(C,N,O) abundance ratio for August 1972 is consistent with all earlier measurements made above that energy which suggests that variations may vanish at high energies. (auth)

26746 SOLAR CYCLE VARIATION IN ENERGETIC PARTICLE EMISSIVITY OF THE SUN. Hakura, Y. (Radio Research Lab., Koganei, Tokyo (Japan)). Solar Phys.; 39: No. 2, 493-497(Dec 1974).

Long-term variation in energetic particle emissivity of the Sun was examined by the use of PCA, solar proton flux, and geomagnetic data from 1941 to 1973. A solar cycle may be divided into three periods in terms of the Sun's particle emissivity. The first period with a peak of emissivity coinciding with the maximum of Zurich sunspot numbers is characterized by the random occurrence of proton flares along the heliographic longitude. On the other hand, active centers were restricted in certain longitude regions and had a tendency to produce a series of major flares in a week or two during the second period. The peak of particle emissivity in this period occurred a few years after the first. Relativistic proton events were observed during both the periods of enhanced particle emissivity. In the third period near the end of the solar cycle, MeV proton events of 27-days recurrency became predominating, though particle emissivity of the Sun itself was relatively low. (auth)

26747 INSTRUMENTAL POLARIZATION CONCERNING MAGNETOGRAPHIC MEASUREMENTS. II. Jaeger, F. W. (Zentralinstitut fuer Solar-Terrestrische Physik, Sonnenobservatorium Einsteinturm, Potsdam, DDR). Solar Phys.; 39: No. 2, 499-504(Dec 1974).

To eliminate the influence of the instrumental polarization from magnetographic measurements an approximate method is presented, which enables one to evaluate with sufficiently high accuracy and practicability the magnetic vector by deriving first the longitudinal field component and the miscentering effect. (auth)

26748 A SEARCH FOR SOLAR NEUTRONS DURING SOLAR FLARES. Ifedili, S. O. (New Hampshire Univ., Durham (USA). Dept. of Physics). Solar Phys.; 39: No. 1, 233-241(Nov 1974).

The upper limit on the solar neutron flux from 1 to 20 MeV has been measured, by a neutron detector on the OGO-6 satellite, to be less than 5×10^{-2} n cm^{-2} s^{-1} at the 95% confidence level for several flares including two flares of importance 3B and a solar proton event of importance 3B. The measurements are consistent with the models proposed by Lingenfelter (1969) and by Lingenfelter and Ramaty (1967) for solar neutron production during solar flares. The implied upper limit on the flux of 2.2 MeV solar gamma rays is about the same as the 2.2 MeV flux observed by Chupp et al. (1973). (auth)

26749 FREQUENCY AND TIME SPLITTING OF DECAMETER SOLAR RADIO BURSTS. II. Chains. Baselyan, L. L.; Goncharov, N. Yu. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki); Zaitsev, V. V.; Zinichev, V. A.; Rapoport, V. O.; Tsybko, Ya. G. (Nauchno-Issledovatel'skij Radiofizicheskij Inst., Gorkij (USSR)). Solar Phys.; 39: No. 1, 223-231(Nov 1974).

The paper deals with the observations of the fine structure of Type III bursts in the 12.5 to 25 MHz band using the UTR-2 (IRE AN UkSSR, Kharkov) radio telescope. A fine structure arises in the form of chains of short-lived narrow-band bursts. The chains have a frequency drift analogous to Type III bursts. Observations allow two different-type chains to be singled out. Ordinary stria-bursts, split pairs, and triplets belong to the first type chains. They may also involve the echo-type phenomena. The second type chains (IIId) involve diffusive stria-bursts, diffusive split-pairs, and triplets. The analysis of a harmonic structure of chains indicates that the first type chains are generated at the frequencies close to the local plasma electron frequency ω_{pe}. The second type

chains and, consequently, diffusive stria-bursts correspond to the second harmonic of the plasma frequency $2\omega_{pc}$. Experimental data evidence that the Type III bursts with a fine structure are excited by the faster particle streams than the ordinary Type III bursts with a diffusive character both of the fundamental and the second harmonic. (auth)

26750 THE PHOTOSPHERIC BARIUM SPECTRUM: SOLAR ABUNDANCE AND COLLISION BROADENING OF Ba II LINES BY HYDROGEN. Holweger, H. (Kiel Univ. (F. R. Germany)); Mueller, E. A. (Observatoire de Geneve, Sauverny, Switzerland). Solar Phys.; 39: No. 1, 19-30(Nov 1974).

A study of the solar Ba II spectrum leads to a solar abundance of barium of $\log\epsilon_{Ba} = 2.11 \pm 0.12$, on the scale $\log\epsilon_H = 12$. The observed asymmetry of the resonance line λ4554 is consistent with an isotopic abundance ratio equal to the terrestrial one. The meteoritic Ba/Si abundance ratio found in carbonaceous chondrites appears to exceed the solar ratio by 0.1 to 0.2 dex. The broadening by collisions with hydrogen atoms is determined from the solar spectrum. Damping half-widths, γ_H, of the three stronger Ba II lines turn out to be larger by a factor of about 3.0 than predicted from pure van der Waals interaction of dipoles. Departures from LTE appear to be present in the cores of the resonance lines and of the lines arising from the metastable 5D levels. The equivalent widths, however, remain practically unaffected. Equivalent widths of neutral barium lines are predicted and some new identifications of photospheric Ba I lines are suggested. (auth)

26751 SOME PROPERTIES OF VELOCITY FIELDS IN THE SOLAR PHOTOSPHERE. V. Spatio-Temporal Analysis of High Resolution Spectra. Deubner, F. L. (Fraunhofer-Institut, Freiburg i.Br., F. R. Germany). Solar Phys.; 39: No. 1, 31-48(Nov 1974).

Series of high-resolution spectrograms taken simultaneously in three spectral regions were recorded with a lambda meter and subjected to a statistical analysis of the fluctuations of Doppler shift and brightness. (1) The 5-min oscillations are confirmed to be "evanescent" waves. Their horizontal wavelengths range from 9 to 15'' and probably still larger values. (2) Horizontal sound waves (Lamb waves) are only of minor importance in the photospheric velocity field. (3) Vertically propagating sound waves are observed and are used to establish a geometrical height scale. The horizontal wave numbers of these sound waves cover a wide range including the scales of both the 5 min oscillations and the granular convection. (4) The inversion of the granular brightness pattern at higher photospheric levels is confirmed for wavenumbers smaller than 8 Mm^{-1}. At $\kappa \sim 10$ Mm^{-1}, however, the correlation of brightness and blue shift observed in the photosphere holds also in lines originating as high as Na I (D_1). This statistical result is related to structures directly visible in spectrograms. (auth)

26752 PHYSICAL PROPERTIES OF SOLAR CHROMOSPHERIC PLAGES. II. Chromospheric Plage Models. Shine, R. A.; Linsky, J. L. (Joint Inst. for Lab. Astrophysics, Boulder, Colo. (USA)). Solar Phys.; 39: No. 1, 49-77(Nov 1974).

Chromospheric models of plages are proposed to explain profiles of the Ca II H, K, λ8498, λ8662 lines described in Paper I (Shine and Linsky, 1972, Solar Phys. 25, 357). These models are consistent with boundary conditions imposed by the photosphere and the Lyman continuum. It is found that increasing emission in these lines is consistent with a picture of increasing temperature gradient in the low chromosphere and the resulting increase in pressure and electron density at similar line optical depths. A way to empirically determine the distribution of chromospheric parameters across the solar disk directly from Ca II filtergrams is suggested. It is proposed that the high-density aspects of solar activity are produced by steep temperature gradients in the low chromosphere and thus by the enhanced heating mechanisms that steepen these gradients. (auth)

26753 POWER SPECTRA OF VELOCITY FLUCTUATIONS IN PLAGES. Teske, R. G. (Aerospace Corp., Los Angeles, Calif. (USA)). Solar Phys.; 39: No. 1, 79-90(Nov 1974).

Spatial power spectral densities of velocities in plages were compared with velocity power spectra of the quiet photosphere. The comparison suggests that photospheric oscillations are not gravity waves. (auth)

26754 THE POLARIZATION OF CONTINUUM RADIATION IN SUNSPOTS. I. Rayleigh and Thomson Scattering. Finn, G. D.; Jefferies, J. T. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Solar Phys.; 39: No. 1, 91-106(Nov 1974).

Expressions are derived for the Stokes parameters of light scattered by a layer of free electrons and hydrogen atoms in a sunspot. A physically reasonable sunspot model was found so that the direction of the calculated linear polarization agrees reasonably well with observations. The magnitude of the calculated values of the linear polarization agrees generally with values observed in the continuum at 5830 Å. Circular polarization in the continuum also accompanies electron scattering in spot regions; however for commonly accepted values of the longitudinal magnetic field, the predicted circular polarization is much smaller than observed. (auth)

26755 MAGNETIC FIELDS IN FLARES AND ACTIVE PROMINENCES. II. The Field Configuration in Some Active Prominences. Tandberg-Hanssen, E. (High Altitude Observatory, Boulder, Colo. (USA)); Malville, J. M. (Colorado Univ., Boulder (USA)). Solar Phys.; 39: No. 1, 107-119(Nov 1974).

The longitudinal magnetic field is studied in a number of active limb prominences showing fields in excess of 30 G. The objects fall into three groups: surges, caps, and active region prominences. There appears to be an upper limit of 150 to 200 G for the field strength in prominences. A model of surges is presented in which a pre-surge axisymmetric magnetic field is established by a line current in the corona. Particle acceleration is observed in surges that indicates $v \times B \neq 0$ in these objects during periods comparable to the Alfvén transit time. The strong fields observed in caps seem to run between parts of active regions in accordance with Hale's law of sunspot group polarities. (auth)

26756 OBSERVED HEIGHTS OF EUV LINES FORMED IN THE TRANSITION ZONE AND CORONA. III. NRL Rocket Observations. Simon, G. W.; Seagraves, P. H. (Sacramento Peak Observatory, Air Force Cambridge Research Labs., Sunspot, N. M., U.S.A.); Tousey, R.; Purcell, J. D. (Naval Research Lab., Washington, D. C. (USA)); Noyes, R. W. (Center for Astrophysics, Cambridge, Mass., U.S.A.). Solar Phys.; 39: No. 1, 121-128(Nov 1974).

Using high-resolution (3 to 5'') rocket spectroheliograms obtained by NRL, hundreds of small, bright, quiet Sun features were analyzed to determine the heights of formation of five transition zone lines: He I 584, He II 304, O V 630, Ne VII 465, and Mg IX 368. The results are in excellent agreement with theoretical model calculations. (auth)

26757 CORONAL HEATING BY ALFVEN WAVES. Wentzel, D. G. (Maryland Univ., College Park (USA)). Solar Phys.; 39: No. 1, 129-140(Nov 1974).

If Alfvén waves are responsible for the heating of the solar corona, what are the various dissipation processes, under what conditions are they important, and what observational consequences may be expected? For wave periods longer than roughly one minute, the corona appears to the waves as turbulent and dissipation is efficient, but little more can be said. For shorter wave periods, a bend or twist in the magnetic field can convert Alfvén waves into fast-mode waves, which then dissipate. But, if the waves travel nearly along the field, the main dissipation occurs via nonlinear interactions among Alfvén waves, near the top of magnetic loops. Once the wave intensity is sufficient so that wave dissipation exceeds radiative energy losses, the temperature rise (ΔT) is limited by electron heat conduction. The basic result is that ΔT is independent of the wave intensity and it is also independent of the electron density. Therefore, regions high and low in the corona are heated similarly. Since ΔT is also proportional to the magnetic pressure, the heating of Alfvén waves naturally outlines regions (loops) of enhanced magnetic fields. A numerical approximation, for wave period $\tau \lesssim 100$ s, is $\Delta T/T \sim 10^{-2.5}B^2 (2 \times 10^6/T)^{5/2} \tau/30$ s. (auth)

26758 ABSOLUTE ABUNDANCES AND DISTRIBUTION OF MATERIAL VERSUS DENSITY AND TEMPERATURE IN A CORONAL CONDENSATION. Magnant-Crifo, F. (Observatoire de Paris, Section de Meudon, 92 (France)). Solar Phys.; 39: No. 1, 141-151(Nov 1974).

Data derived from coronal eclipse spectra in the visible range are analyzed in terms of electron density and temperature in a coronal condensation using the method recently developed by Jefferies, Orrall, and Zirker. A mean density and a certain amount of material are associated to each temperature. Abundances relative to Fe are derived for Ni, Cr, Mn, S, Ca. The absolute abundance of Fe is found to be 2×10^{-5}. No absolute calibration is required. It appears that there must exist a non-negligible amount of "cold" material ($T_e < 10^6$K) in the corona, which cannot be observed in the visible spectral range. (auth)

26759 DISCONTINUITY IN THE MICROWAVE SLOWLY VARYING COMPONENT OBSERVED AT 20:02 UT, JUNE 16, 1972. Covington, A. E. (National Research Council of Canada, Ottawa, Ontario, Astrophysics Branch). Solar Phys.; 39: No. 1, 153-154(Nov 1974).

The observations of a brief flaring region between two plages on the eastern limb of the Sun and the subsequent coronal transient are reported for June 16, 1972 by Koomen et al. (1974). Both of these events have unambiguous and closely timed associations

with the solar noise bursts observed at 2800 and 2700 MHz and are also accompanied with good x-ray and SID effects but faint subflare (Solar-Geophysical Data). The two frequencies are those monitored at widely separated stations operated by the Astrophysics Branch of the National Research Council at Lake Traverse, Ontario and at Penticton, B. C. (auth)

26760 OSO-7 OBSERVATIONS OF SOLAR X-RAYS IN THE ENERGY RANGE 10-100 keV. Datlowe, D. W.; Elcan, M. J.; Hudson, H. S. (California Univ., La Jolla, San Diego (USA)). Solar Phys.; 39: No. 1, 155-174(Nov 1974).

The solar x-ray experiment on the satellite OSO-7 has provided extensive observations of hard and soft x-ray bursts. A general description of the hard x-ray data is given, in parallel with the description of the soft x-ray data already published. The data for this study consist of 123 hard x-ray bursts which occurred between 10 October 1971 and 6 June 1972. The behavior of a typical event is examined in terms of its spectral and flux variations. For the whole data sample, it is found that two-thirds of the soft x-ray bursts have detectable hard x-ray emission. The distributions of frequency of occurrence of peak flux, spectral index, collisional energy loss, burst duration, and the duration at half maximum of the flux profile are presented. No correlation was found between the flux and the spectral slope of an individual data sample, nor was there a correlation between the peak flux and the full width at half maximum of a burst. Hα flare identifications were utilized to study longitude variations. No statistically significant variation was found in the relative frequency of hard or soft x-ray bursts with longitude. However, the spectral slope does exhibit a center-to-limb variation, with limb spectra tending to be softer. The growth of energy in the hot flare plasma (soft x-ray source) was compared with the collisional energy deposition (hard x-ray source) for the entire sample. This analysis shows that collision loss within the hot plasma is not the principal source of its heating. (auth)

26761 A TWO-COMPONENT THERMAL MODEL OF X-RAY BURST SOURCES. Herring, J. R. H. (University Coll., London (UK). Mullard Space Science Lab.). Solar Phys.; 39: No. 1, 175-192(Nov 1974).

A semi-empirical model of the soft x-ray source associated with solar flares is presented, based on the results of the two temperature analysis of OSO-5 data obtained by Herring and Craig (1973). The model makes use of a jet of plasma rising from the solar surface as the basic origin of the soft x-ray emitting region, and gives rise to a cool region caused by randomisation of the jet, and a hot region caused by a shock front. Two different geometries are examined, and the model allows flow velocities and electron densities to be calculated. (auth)

26762 TYPE III SOLAR RADIO BURSTS OBSERVED AT 169 MHz: HEIGHT AND RELATIVE POSITIONS IN PAIRS. Mercier, C. (Observatoire de Paris, Section de Meudon, 92 (France)); Rosenberg, H. (Harvard Coll. Observatory, Cambridge, Mass. (USA)). Solar Phys.; 39: No. 1, 193-206(Nov 1974).

Seventy-six Type III solar radio bursts or burst groups occurring over 41 days in the period November 1968 to July 1971 were studied with high time and spatial resolution at 169 MHz and high time and spectral resolution between 160 and 320 MHz. The average height of the sources at 169 MHz was found to be 0.34 ± 0.03 $R_\odot$ above the photosphere. This result is discussed in terms of scattering effects, refraction effects, nonvalidity of the radial hypothesis, and the dispersion in actual height. The occurrence of fundamental-harmonic pairs and their position is discussed, and the arguments in favor of emission at the fundamental or at the harmonic of the local plasma frequency for the majority of all Type III bursts are presented. The greater probability of the latter hypothesis is pointed out. (auth)

26763 POLARIZATION FEATURES OF TYPE IV BURSTS. Boehme, A.; Fuerstenberg, F.; Krueger, A. (SEE CODE-7041275 Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic). Heinrich-Hertz-Inst. fuer Solarterrestrische Physik). Solar Phys.; 39: No. 1, 207-211(Nov 1974).

Using both the polarization records of the central Institute for Solar-Terrestrial Physics, Berlin at seven different frequencies and polarization records from other stations, the spectral diagrams of some important Type IV bursts are completed by polarization diagrams. Combining both types of diagrams and adding the results of optical observations and x-ray data it is possible to come to a deeper understanding of the processes taking place during strong solar radio bursts.

26764 FREQUENCY AND TIME SPLITTING OF DECAMETER SOLAR RADIO BURSTS. I. Elementary Events. Baselyan, L. L.; Goncharov, N. Yu. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki); Zaitsev, V. V.; Zinichev, V. A.; Rapoport, V. O.; Tsybko, Ya. G. (Nauchno-Issledovatel'skij Radiofizicheskij Inst., Gorkij (USSR)). Solar Phys.; 39: No. 1, 213-222(Nov 1974).

The paper deals with the stria-burst observations by the UTR-2 radio telescope (IRE AN UkSSR, Kharkov) at the frequencies of 12.5 to 25 MHz. Two varieties of these bursts are pointed out: ordinary stria-bursts and diffusive stria-bursts. The ordinary stria-bursts may occur isolated, as split-pairs and splitted triple bursts (triplets). At the frequency 25 MHz, the ordinary stria-bursts are characterized by the average duration about 1 s, the band width 0.07 MHz and the frequency drift 0.07 MHz s^{-1}. A scale of the frequency splitting in pairs and triplets is 0.1 MHz. The diffusive stria-bursts have essentially larger duration (of the order of 10s) and no visible frequency drift. Like the ordinary stria-bursts, the diffusive ones may appear isolated and in the form of split-pairs and triplets. The occurrence of echoes is typical of both types of stria-bursts which are a succession of two or several (multiple echoes) similar bursts separated by the time interval 1.5 to 2.5 s for the ordinary and by 3 to 10 s for the diffusive stria-bursts. Sometimes the bursts with two scales of the frequency splitting are observed. (auth)

26765 THE LARGE-SCALE SOLAR MAGNETIC FIELD. Altschuler, M. D.; Trotter, D. E.; Newkirk, G. Jr. (High Altitude Observatory, Boulder, Colo. (USA)); Howard, R. (Hale Observatories, Pasadena, Calif. (USA)). Solar Phys.; 39: No. 1, 3-17 (Nov 1974).

The large-scale photospheric magnetic field, measured by the Mt. Wilson magnetograph, has been analyzed in terms of surface harmonics ($Pn^m(\theta)$ cos $m\phi$ and $Pn^m(\phi)$ sin $m\phi$) for the years 1959 through 1972. The single harmonic which most often characterized the general solar magnetic field throughout the period of observation corresponds to a dipole lying in the plane of the equator (2 sectors, $n = m = 1$). This 2-sector harmonic was particularly dominant during the active years of solar cycles 19 and 20. The north-south dipole harmonic ($n = 1$, $m = 0$) was prominent only during quiet years and was relatively insignificant during the active years. (The derived north-south dipole includes magnetic fields from the entire solar surface and does not necessarily correlate with either the dipole-like appearance of the polar regions of the Sun or with the weak polar magnetic fields.) The 4-sector structure ($n = m = 2$) was prominent, and often dominant, at various times throughout the cycle. A 6-sector structure ($n = m = 3$) occasionally became dominant for very brief periods during the active years. Contributions to the general solar magnetic field from harmonics of principal index $4 \leq n \leq 9$ were generally relatively small throughout this entire solar cycle with one outstanding exception. For a period of several months prior to the large August 1972 flares, the global photospheric field was dominated by an $n = 5$ harmonic; this harmonic returned to a low value shortly after the August 1972 flare events. Rapid changes in the global harmonics, in particular, relative and absolute changes in the contributions of harmonics of different principal index n to the global field, imply that the global solar field is not very deep or that very strong fluid flows connect the photosphere with deeper layers. (auth)

26766 SOLAR FLUX AND ITS VARIATIONS. Smith, E. V. P.; Gottlieb, D. M. (Maryland Univ., College Park (USA)). Space Sci. Rev.; 16: No. 5-6, 771-802(Nov 1974).

Data are presented on the solar irradiance as derived from a number of sources. An attempt was made to bring these data onto a uniform scale. Summation of fluxes at all wavelengths yields a figure of 1357.826 W m^{-2} for the solar constant. Estimates are made of the solar flux variations due to flares, active regions (slowly varying component), solar rotation, and the 11-year cycle. Solar activity does not produce a significant variation in the value of the solar constant. Nevertheless, variations in the x-ray and extreme ultraviolet portions of the solar flux may be several orders of magnitude during solar activity, especially at times of major flares. It is well established that these short wavelength flux enhancements cause significant changes in the terrestrial ionosphere. (auth)

26767 MULTI-CHANNEL SYSTEM FOR INVESTIGATING THE CHARACTERISTICS OF THE SPORADIC SOLAR RADIO EMISSION. Chekalev, S. P.; Vedeneev, Yu. B.; Proidakov, V. I.; Prytkov, N. M.; Khrulev, V. V.; Shmulevich, S. A. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 6, 920-922(1974). (In Russian).

A six-channel automatic system for the preliminary computer processing of data on the characteristics of the sporadic solar radio emission was developed and its characteristics are described. The system permits the continual processing of the statistical characteristics of microwave flares and radio emissions of Type IV. (JSR)

26768 EXPLORING THE SOLAR SYSTEM. II. Models of the Origin. Metz, W. D. Science; 186: No. 4166, 814-818 (29 Nov 1974).

The nebular hypothesis of LaPlace theorizes that the solar system was formed from the contraction of an interstellar cloud. Arguments rage over the mass of the nebula that formed the solar system, the forces that shaped it, the pressure and temperature that characterized it, and the role of the Sun in its development. The two most acceptable models seem to be from the American school that postulated that the planets formed first out of a massive solar nebula and the Russian school postulated that the Sun formed first out of a very much smaller solar nebula. No solar system model describes Sun and planets in a common framework, although they must have collapsed out of the same nebula. Modeling work in both schools to date is described. Chemical condensation sequence in the solar nebula is discussed and analyzed for the condensed bodies, the Moon, Mercury, Venus, Earth, Mars, the Asteroids, Ganeymede, Callisto, and Titan. Jupiter and Saturn that are more than 95% volatiles are not included. (MCW)

26769 LONG-TERM VARIATIONS OF THE SOLAR WIND PROTON PARAMETERS. Diodato, L. (Consiglio Nazionale delle Ricerche, Rome); Moreno, G.; Signorini, C.; Ogilvie, K. W. J. Geophys. Res.; 79: No. 34, 5095-5108(1 Dec 1974).

Interplanetary plasma data taken near 1 AU by a variety of spacecraft (Imp 1, Vela 2-4, Explorer 33-35, and Heos 1) from 1963 to 1971 are used to study the long-term variations of the solar wind proton properties. An intercalibration among the different experiments is performed in order to obtain a coherent set of data. The most interesting result is a ~40% reduction of the proton density between the minimum and the maximum of the solar activity cycle. The observed density variation occurs throughout the velocity range; however, a limited sample of data could suggest that at very low velocities ($V < 300$ km/s) the density is independent of the solar activity. The proton bulk velocity is remarkably constant during the period considered: small increases of the average speed occurring in 1968 and 1971 cannot be attributed to the solar cycle. No clear trend is exhibited by the proton temperature: differences among the various experiments probably have an instrumental origin. The density modulation has been interpreted in terms of the heliographic latitude effect proposed by Hundhausen et al. (1971). It turns out that with increasing solar activity this effect disappears, producing the observed decrease of the average density near the solar maximum. (auth)

26770 STEADY STATE ASYMMETRIC PLANETARY ELECTRICAL INDUCTION. Horning, B. L.; Schubert, G. (Univ. of California, Los Angeles). J. Geophys. Res.; 79: No. 34, 5077-5088(1 Dec 1974).

An analytic solution is presented for the steady state electric and magnetic fields induced by the motional electric field of the solar wind in the atmosphere or interior of a planet that is asymmetrically surrounded by solar wind plasma. The electrically conducting ionosphere or interior must be in direct electrical contact with the solar wind over the day side of the planet. The conducting region of the planet is modeled by a sphere or a spherical shell of arbitrarily stratified electrical conductivity. A nonconducting cylindrical cavity is assumed to extend downstream on the night side of the planet. The solar wind is assumed to be highly conducting so that the induced fields are confined to the planet and cavity. Induced currents close as sheet currents at the solar wind-cavity and solar wind-planet interfaces. Numerical evaluation of the analytic formulas are carried out for a uniformly conducting spherical model. Among the quantities computed are (1) the induced electrical and magnetic fields, which are compared to those of the spherically symmetric theory, (2) the total current through the body and the total power dissipated in the planet, which are reduced 25% in comparison with those of the spherically symmetric theory, (3) the radial electromagnetic stress on the incident plasma, which is found to be asymmetric over the subsolar hemisphere and strongly dependent upon the spiral angle of the interplanetary magnetic field, and (4) the flow pattern of the sheet currents. (auth)

26771 STATISTICAL SURVEY OF SCNAs OVER HALF SOLAR CYCLE. Ahmed, I.; Rao, B. R. (Andhra Univ., Waltair, India). Indian J. Radio Space Phys.; 3: No. 2, 150-152(Jun 1974).

A study of the characteristics of sudden cosmic noise absorption (SCNA) is made in order to investigate into their variations from IGY to IQSY. The necessary data for the investigation are taken from CRPL-Part B (now NOAA) series as reported by 5 observatories in the American Zone. The entire period of analysis (1958-65) is divided into 3 groups, viz. periods of high, medium and low solar activity, and the optical flares associated with the SCNA are divided into three classes, viz. 1, 2 and 3. The analysis reveals that the SCNA size has an increasing tendency with decreasing solar activity. The growth-time associated with class 1 flares is observed to be decreasing with decreasing solar activity, while for the class 2 and class 3 flares the reverse is the case. The time of decay of the SCNA shows a decrease with decrease in the level of solar activity. No systematic latitudinal variation is observed in the case of the size, growth-time and decay-time of the SCNAs. (auth)

26772 SOME STUDIES ON THE NATURE OF SOLAR X-RAY FLARES. Das Gupta, M. K. (Center of Advanced Study in Radio Physics and Electronics, Calcutta); Mitra, R. K.; Sarkar, S. K. Indian J. Radio Space Phys.; 3: No. 2, 137-139(Jun 1974).

Peak flux and the rate of rise of solar x-ray flares numbering 2500 recorded by Solrad 9 (Explorer 37) during the period January 1969 to December 1971 in the ban.. 1 to 8 Å were examined in relation to their duration and ratio of rise time/duration. Results obtained from the statistical analysis strongly suggest that x-ray flares can be broadly divided under three definite types: impulsive, gradual rise and fall, and gradual rise and quick fall. (auth)

26773 PROMPT EFFECTS OF SOLAR FLARE OBSERVED SIMULTANEOUSLY ON THE RADIO WAVE PROPAGATION CHARACTERISTICS IN THE lf, vlf, AND hf BANDS. Sen, A. K.; Saha, B.; Trehan, S. K.; Chatterjee, S. K. (Univ. of Calcutta). Indian J. Radio Space Phys.; 3: No. 2, 140-141(Jun 1974).

Simultaneous observations of the field strength of lf and hf signals and the integrated field intensity of vlf atmospherics made in Calcutta (lat., 22°34′N; long., 88°24′E) and that of the frequency deviation of a standard frequency hf signal made in the ionospheric field station at Haringhata (lat., 22°58′N; long., 88°30′E) revealed some interesting features of the association between the ionospheric effects of a solar flare, in the three frequency bands. The results indicate that a great majority of SIDs observed by SWF, SES and SEA methods are not associated with SFD phenomena and that an SFD tends to be associated with a relatively weak SID observed by the other methods. The observations suggest that the majority of flares producing a D-region effect are not accompanied by EUV emission sufficient for producing an SFD, while flares producing a large EUV emission are relatively weak emitters of X-rays responsible for a D-region effect. (auth)

26774 RESPONSE OF AN ISOTHERMAL BOUNDED ATMOSPHERE TO AN APPLIED RANDOM BODY-FORCE. Berthomieu, G. (Observatoire de Nice, 06 (France)). Solar Phys.; 38: No. 2, 311-319(Oct 1974).

The response of a one-dimensional isothermal atmosphere with rigid lower boundary and bounded upward by a very hot isothermal atmosphere to an applied random source is studied. It is shown that a concentrated white noise source merely excites the damped eigen-modes of the model and that the enhanced response at the cut-off frequency found in semi-infinite isothermal model is removed by the reflections. It is believed that this rules out the attempts to relate the photospheric and chromospheric oscillations to the singular response of an excited semi-infinite isothermal atmosphere. (auth)

26775 ON THE DETERMINATION OF THE PHOTOSPHERIC VELOCITY DISTRIBUTION FROM PROFILES OF WEAK FRAUNHOFER LINES. Rutten, R. J.; Hoyng, P.; de Jager, C. (The Astronomical Institute, Utrecht, The Netherlands). Solar Phys.; 38: No. 2, 321-336(Oct 1974).

The conditions are derived, under which the profile of a weak Fraunhofer line can be described as the convolution of the separate profiles of damping, thermal and nonthermal motions at the average depth of formation of the line. The average velocity distribution along the line of sight, rather than its customary chosen macro- and micro-turbulent components, is then found from the deconvolution of the observed profile with the known other contributions. Reversely, the observed profiles can be compared to predicted profiles on the basis of De Jager's (1974) theoretical turbulence broadening curves. These two methods are tested on four suitable lines. The results indicate a non-gaussian velocity distribution with a rms velocity of about 3 km s^{-1} and show that the photospheric turbulence is not incompatible with Kolmogoroff's law. (auth)

26776 STUDIES OF GRANULAR VELOCITIES. VI. Changes in the Granular Velocity Field Around Sunspots. Mattig, W.; Nesis, A. (Fraunhofer Institut, Freiburg i. Br., F. R. Germany). Solar Phys.; 38: No. 2, 337-341(Oct 1974).

Observations with the image intensifier tube at the Coude refractor in Capri seem to confirm that the velocity field near sunspots contains more small scale fluctuations than in nonactive regions, and that these fluctuations decrease more rapidly with height. (auth)

26777 DETERMINATIONS OF ATOMIC LIFETIMES FOR THE RARE EARTH IONS: PrII, TmII, LuII, CeIII. Andersen, T.; Soerensen, G. (Aarhus Univ. (Denmark)). Solar Phys.; 38: No. 2, 343-350(Oct 1974).

Radiative lifetimes have been determined by the beam-foil method for some excited states in the singly ionized rare earths PrII, TmII, and LuII, in order to test the reliability of the transition probabilities and oscillator strengths found by Corliss and Bozman and usually applied for solar abundance determinations. Correction factors of ~4.5, ~2.5, and ~0.3 should be applied to Corliss and Bozman's values for PrII, TmII, and LuII, respectively. These corrections eliminate the discrepancies between the abundance in the solar photosphere and in meteorites for Pr and Tm. Radiative lifetimes for CeIII are also reported. (auth)

26778 LINE INTENSITIES IN THE PHOTOSPHERE–CHROMOSPHERE TRANSITION REGION. III. Empirical NLTE Analysis of FeI Lines. van Dessel, E. L. (Kon. Sterrewacht van Belgie, Ringlaan 3, B-1180 Brussels, Belgium). Solar Phys.; 38: No. 2, 351-366(Oct 1974).

FeI lines observed during the 1961 eclipse at Brac, Yugoslavia (see paper II; van Dessel et al., 1973) are analysed using a computer program for the calculation of theoretical line intensities, which was described in Paper I (van Dessel, 1970). A few minor modifications to the physical input are discussed. NLTE-coefficients, affecting the line absorption coefficient and the source function, are introduced and discussed. Starting from coefficients derived from the combination T_{el} (HSRA) + T_{ex} (Holweger), suitable distributions with height of the NLTE-coefficients are determined for the most striking cases among the observed lines. Only little deviation from the populations derived from Holweger's temperature distribution is needed to explain the observed line behavior. (auth)

26779 PARTIALLY COHERENT SCATTERING MODELS FOR THE FORMATION OF THE CHROMOSPHERIC CaII K LINE. Vardavas, I. M. (Sydney Univ. (Australia). Dept. of Applied Mathematics); Cram, L. E. (National Measurement Lab., Sydney (Australia)). Solar Phys.; 38: No. 2, 367-376(Oct 1974).

A model for the formation of the chromospheric CaII K line is discussed which does not make the usual assumption of complete redistribution. Using a physically reasonable scattering model, significant departures are found due to the frequency dependence of the line source function, particularly in the relative intensity and centre-to-limb behavior of the K_1 parts of the line and in the asymmetry produced by differential velocity fields. It is concluded that the frequency dependence of the K line source function must be considered in quantitative models for the formation of the K line. (auth)

26780 HIGH-RESOLUTION PHOTOGRAPHY OF THE SOLAR CHROMOSPHERE. XIII. Hα Contrast Profiles of Sunspot Fibrils. Bray, R. J. (National Measurement Lab., Sydney (Australia)). Solar Phys.; 38: No. 2, 377-388(Oct 1974).

High-resolution filtergrams of a sunspot and its surroundings, taken at seven wavelengths in Hα with the aid of a computer-controlled 1/8 Å filter, have been used to derive the contrast of ten sunspot superpenumbra fibrils as functions of wavelength. The observed contrast profiles are compared with profiles calculated on the basis of three theoretical models, namely, Beckers' (1964) "cloud" model, Athay's (1970) "velocity" model, and a "pure Doppler shift" model. However, none of these models in their present form account for all the observed profiles. Arguments are presented which suggest that, in addition to line-of-sight velocity, the height of a moving chromospheric structure relative to the region over which the Hα line is formed plays a decisive role in shaping the observed profile. Improvements to existing theoretical treatments are suggested. The nature of the fibril velocity field is discussed briefly. (auth)

26781 THE BRIGHTENING OF SUNSPOT UMBRA OBSERVED ON 29 OCTOBER, 1972. Kubota, J.; Tamenaga, T.; Kawaguchi, I.; Kitai, R. (Kyoto Univ. (Japan)). Solar Phys.; 38: No. 2, 389-398 (Oct 1974).

Brief descriptions are given of the spectroscopic and the monochromatic observations of the umbral brightening on 29 October, 1972. The source of the brightening is attributed to the kinetic energy of the infalling coronal matter with a final velocity of 200 km s^{-1}, into the umbral gas. The spectra of this brightening reveal many hydrogen and metallic emission lines. The variety of the widths of these lines indicates the existence of complex nonthermal velocity field and of the stratification of various emitting conditions in the umbral brightening. The kinetic energy of the falling matter would be expended not only for producing the emissions, but also for exciting the complex velocity field of nonthermal motion. (auth)

26782 THE NATURE OF RUNNING PENUMBRAL WAVES. Nye, A. H.; Thomas, J. H. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Solar Phys.; 38: No. 2, 399-413(Oct 1974).

A model of a sunspot penumbra, including the effects of magnetic field, compressibility, and buoyancy, is studied in order to identify the mode of running penumbral waves. It is found that the penumbral waves may be identified with gravity-modified magneto-acoustic waves of the "plus" type that are vertically trapped at photospheric levels. Although most of the wave energy is contained in the penumbral photosphere and subphotosphere, the maximum vertical velocity occurs in the chromosphere where (i) the waves are evanescent and (ii) the vertical velocity is in fact observed (in Hα). (auth)

26783 CALIBRATION OF OSO-7 Fe XV 284A SPECTROHELIOGRAMS IN SOLAR-GEOPHYSICAL DATA BULLETIN. Chapman, R. D. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Solar Phys.; 38: No. 2, 415-417(Oct 1974).

This note gives the photometric calibration factor for the OSO-7 x-ray and EUV spectroheliograph as a function of date. (auth)

26784 CORONAL ELECTRIC CURRENTS PRODUCED BY PHOTOSPHERIC MOTIONS. Heyvaerts, J. (Observatoire de Paris, Section de Meudon, 92 (France)). Solar Phys.; 38: No. 2, 419-437(Oct 1974).

Due to its high electrical conductivity along field lines, the corona provides an electric coupling between those remote points in the photosphere which are linked by coronal lines of force. This coupling essentially acts as a shunt for potential differences induced between such points by the electromotive fields created by photospheric motions. As a result, important coronal currents are driven. This paper studies the implications of this idea for a model which schematizes both the magnetic configuration and the photospheric motions observed in flare producing regions. In this particular geometry, coronal currents would be mainly driven along a sheet, whose trace in the plane of the photosphere would look as a two-ribbon structure on both sides of an inversion line of the photospheric polarity. It is shown that vertical currents of the order of 10^{-2}, 10^{-1} A m^{-2} can be generated, and possibly interrupted if the photospheric flow velocity exceeds about 1 km s^{-1}, then releasing the 10^{32} ergs of magnetic energy previously stored in the circuit. (auth)

26785 SOLAR CYCLE VARIATION OF LARGE-SCALE CORONAL STRUCTURES. Antonucci, E.; Duvall, T. L. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Solar Phys.; 38: No. 2, 439-447(Oct 1974).

A green line intensity variation is associated with the interplanetary and photospheric magnetic sector structure. This effect depends on the solar cycle and occurs with the same amplitude in the latitude range 60°N–60°S. Extended longitudinal coronal structures are suggested, which indicate the existence of closed magnetic field lines over the neutral line, separating adjacent regions of opposite polarities on the photospheric surface. (auth)

26786 A COMPARISON OF THREE SOLAR ACTIVE REGIONS BASED ON THEIR SOFT X-RAY LINE SPECTRA. Brabban, D. H. (Mullard Space Science Lab., Dorking (UK)). Solar Phys.; 38: No. 2, 449-464(Oct 1974).

A rocket-borne, collimated spectrometer has obtained the soft x-ray (1.0 to 2.2 nm) spectra of three solar active regions. The principal features of the spectra are described and are then used to determine the conditions in the active regions. An isothermal (single temperature) model is not able to describe the observed spectra so that a continuous distribution of emission measure with temperature is introduced. This distribution, based on that proposed by Chambe, is then used to investigate the structure of the active regions. Several simple models are considered. It is shown that each active region has a hot, dense core surrounded by a large outer volume through which the temperature and density fall until normal coronal conditions are reached. Two of the regions exhibited similar characteristics with the cores having electron densities ~10^{10} cm^{-3} and temperatures of at least 4×10^6K. Even the third region, which was much less impressive and quite compact in Hα, appears to have had a small amount of this dense plasma in its central core. (auth)

26787 THE ALFVÉN-WAVE THEORY OF SOLAR FLARES. Piddington, J. H. (National Measurement Lab., Sydney (Australia)). Solar Phys.; 38: No. 2, 465-481(Oct 1974).

Evidence is discussed showing that a representative solar flare event comprises three or more separate but related phenomena requiring separate mechanisms. In particular it is possible to separate the most energetic effect (the interplanetary blast) from the thermal flare and from the rapid acceleration of particles to high energies. The phenomena are related through the magnetic structure characteristic of a composite flare event, being a bipolar surface field with most of its field lines "closed". Of primary importance are helical twists on all scales, starting with

the "flux rope" of the spot pair which was fully twisted before it emerged. Subsequent untwisting by the upward propagation of an Alfvén twist wave provides the main flare energy. (auth)

26788 ACCELERATION OF ELECTRONS IN ABSENCE OF DETECTABLE OPTICAL FLARES DEDUCED FROM TYPE III RADIO BURSTS, Hα ACTIVITY AND SOFT X-RAY EMISSION. Kane, S. R. (California Univ., Berkeley (USA). Space Sciences Lab.); Kreplin, R. W. (Naval Research Lab., Washington, D. C. (USA)); Martres, M. J.; Pick, M.; Soru-Escaut, I. (Observatoire de Paris, Section de Meudon, 92 (France)). Solar Phys.; 38: No. 2, 483-497(Oct 1974).

The relationship between Hα absorption features, Type III radio bursts and soft x-ray emission has been examined in order to determine the characteristics of the particle acceleration process operating when a Hα-flare may not be detectable. It is found that transient Hα activity observed in the absence of reported flares is associated with production of relatively weak Type III radio and soft x-ray emission. Since such optical phenomena are much more frequent than flares themselves, it is concluded that instabilities generating fast particles may be produced in the corona in a quasi-continuous way with coincident perturbations in the lower solar atmosphere. The soft x-ray component, which is similar to the precursor in flares, is not necessarily the direct product of fast particles, but is probably associated with some type of heating since both the soft x-ray emission and the Hα features exhibit a similar evolution, the type III bursts occurring near the maximum of this perturbation. The observations are consistent with a model in which the electron acceleration region is located at an altitude where the ion density is $\sim 10^9$ cm^{-3} and most of the accelerated electrons ($\gtrsim$20 keV) are confined to coronal altitudes where the ion density is $\lesssim 10^{10}$ cm^{-3}. (auth)

26789 ANALYSIS OF THE AUGUST 7, 1972 WHITE LIGHT FLARE: ITS SPECTRUM AND VERTICAL STRUCTURE. Machado, M. E.; Rust, D. M. (Sacramento Peak Observatory, Air Force Cambridge Research Laboratories, Sunspot, N. M. 88349, USA). Solar Phys.; 38: No. 2, 499-516(Oct 1974).

Spectral data on a white light wave occurring during the explosive phase of the August 7 flare were obtained simultaneously with three telescopes at the Sacramento Peak Observatory. Spectrograms in the region λλ3530 to 5895 and sequences of filtergrams (~200 Å halfwidth) at 4950 Å and 5900 Å constitute the most complete record of white light flare emission obtained to date. Analysis of the iron line spectrum and of the CN and CH molecular lines shows that the maximum depth of the emission in the flare wave is about 200 km above the photosphere of the Harvard–Smithsonian Reference Atmosphere. Analysis of the Balmer lines gives an electron density of 3×10^{13} cm^{-3} where the continuum emission is present. From the Balmer line analysis, it is concluded that, in agreement with Canfield (1974) and Shmeleva and Syrovatskii (1973), the flare occurs in a thin layer and that the heating and ionization of the flaring layers are due to the injection of 100 keV electrons. There is no need to postulate filamentary structure in the flaring layer in order to explain the observations. Analysis of the continuum emission in the wave indicates that it is produced by free–bound transitions of hydrogen at a temperature of ~8500 K. In the impulsive phase of the flare emission arose from short-lived bluish knots which could not be studied in detail. In the following phase, the one to which the conclusions in this paper refers, the continuum emission coincided with the Hα ribbon expansion (the explosive phase). It is identified with the "yellowish-white" flares reported by Trouvelot (1891) and others. (auth)

26790 TESTS OF 4 SINGLE-STAGE IMAGE INTENSIFIER TUBES FOR SOLAR SPECTROSCOPY. Brandt, P. N.; Wiesmeier, A. (Fraunhofer Institut, Freiburg Br., F. R. Germany). Solar Phys.; 38: No. 2, 517-521(Oct 1974).

Atmospheric image degradation can be reduced by shortening the exposure time. Therefore, four single-stage electrostatically focused image intensifier tubes with fiber optic output were tested in the laboratory for their suitability in solar spectroscopy. Under the premise that the spatial and spectral image scales (Capri: 5.9'' mm^{-1} and 9 mm Å^{-1}, resp.) should not be changed by a premagnification, the RCA tube 8605/V1 in combination with Copex Pan Rapid film turns out as the best choice. It yields a resolution of 55 line-pairs mm^{-1} and a gain of exposure time by a factor of ~14 over Kodak IV-E in the red, with only little increase of photometric noise but appreciable pin-cushion distortion. (auth)

26791 ON THE SUN'S DIFFERENTIAL ROTATION. Implications of the Difference in Angular Velocity Between the Sunspots and Photosphere. Durney, B. R. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Solar Phys.; 38: No. 2, 301-309 (Oct 1974).

It is assumed that the meridional motions (U) and angular velocity (Ω) in the surface layers of the convection zone are given by simple expressions of the form: $U_r = 2\psi(r)P_2(\cos\theta)/\rho r^2$, $U_\theta = -\psi'(r)\sin\theta\cos\theta/\rho r$, and $\Omega = \Omega_0[1 + \omega_0(r) + \omega_2(r)P_2(\cos\theta)]$. Here $\psi(r)$ is the stream function, $P_2(\cos\theta)$ the second order Legendre polynomial, and θ the polar angle. Allowance is made for a possible difference in the rate of momentum exchange between the directions parallel and perpendicular to gravity by introducing an anisotropic turbulent viscosity coefficient, μ, which is assumed furthermore to be proportional to the density, ρ; $\mu = \rho\nu$, and $\nu_{\theta\theta} = \nu_{\phi\phi} = s\nu_{rr}$. It is shown that if the sunspots give an indication of the Sun's angular velocity at a depth h(~3×10^4km) then the turbulent viscosity is necessarily anisotropic. The radial variation introduced by this anisotropy seems to explain well the sunspot data if it is assumed that the sunspots act as tracers of the Sun's angular velocity. (auth)

26792 STUDIES OF SOLAR MAGNETIC FIELDS. I. The Average Field Strengths. Howard, R. (Hale Observatories, Pasadena, Calif. (USA)). Solar Phys.; 38: No. 2, 283-299(Oct 1974).

The telescope, spectrograph, and magnetograph at the 150-ft Tower Telescope are described, and a chronology of changes in the instrumentation is given. The average magnetic field strengths over the last seven years are discussed. The changes in polarity at the poles of the Sun are described. The characteristics of these polarity reversals at both poles are similar. A reversal is not seen in the sunspot latitudes ($\lesssim 40°$) but is observed to start in the 40 to 50° zone and proceed slowly poleward, reaching the pole within 12 to 18 months. At the time of the polarity reversal at the pole, field strengths over a large portion of the disk show similar behavior. Rapid changes of solar magnetic fields over large portions of the solar disk are discussed. Two possible models are suggested to explain the frequent "monopole" appearance of the solar fields. The poleward drift of the magnetic field reversals in each hemisphere was not closely in phase with the polar filament migrations or the variations in mean latitude of high-latitude coronal activity. The behavior of the low-latitude field strengths with phase in the cycle follows earlier correlations of activity with predominantly negative magnetic fields. (auth)

26793 SOLAR FLARE PARTICLES: ENERGY–DEPENDENT COMPOSITION AND RELATIONSHIP TO SOLAR COMPOSITION. Crawford, H.J.; Price, P.B.; Cartwright, B.G.; Sullivan, J.D. (Department of Physics, University of California, Berkeley). Astrophys. J. 195: No. 1, 213-221 (1 Jan 1975).

Plastic and glass track detectors on rockets and Apollo spacecraft have been used to determine the composition of particles from He to Ni at energies from ~0.1 to ~ 50 MeV per nucleon in several solar flares of widely varying intensities. At low energies the composition of solar particles is enriched in heavy elements by an amount, relative to the asymptotic high–energy composition that increases with atomic number from $Z=2$ up to at least $Z\simeq 50$, that decreases with energy and that varies from flare to flare. At high energies (usually beyond an energy of ~5 to ~20 MeV per nucleon) the composition becomes independent of energy and, though somewhat variable from flare to flare, approximates the composition of the solar atmosphere. A table of abundances of the even–Z elements from He to Ni (plus N) in solar particles is constructed by averaging the asymptotic high–energy abundances in several flares. The similarity between these solar particle abundances and recent abundance data for the photosphere and corona is so close that the few discrepancies (mainly S and Ar) are attributed to errors in the solar abundance tables. The suggested revisions, S/Si=0.17 and Ar/Si $\leq$ 0.04, would require significant changes in the models of nucleosynthesis of the elements Si to Fe by explosive oxygen and silicon burning. (auth)

26794 REMARKS ON SEQUENCE–OF–PLASMA–INSTABILITIES MODELS OF SOLAR FLARES. Coppi, B. (Università di Torino, Torino, Italy). Astrophys. J. 195: No. 2, 545-552 (15 Jan 1975).

The main requirements of solar flare models that explain their development in terms of an appropriate sequence of plasma instabilities are discussed. This sequence is characterized by a "preheating phase" of the local chromospheric plasma, a "flash phase" resulting from an explosive instability leading to particle acceleration and onset of plasma turbulence, and in the case of large flares by a "hot phase" in which a significant amount of magnetic energy is converted into plasma flow and thermal energy. The relevant evolution of the electron distribution function and the two–dimensional flow and magnetic field configurations that can be consistent with the above–mentioned model are considered. (auth)

26795 OXYGEN–TO–NEON ABUNDANCE RATIO IN THE SOLAR CORONA. Acton, L.W.; Catura, R.C.; Joki, E.G. (Lockheed Palo Alto Research Laboratory). Astrophys. J. Lett. 195: No. 2, L93-L95 (15 Jan 1975).

The oxygen–to–neon abundance ratio in the solar corona is determined to be 4.7 ± 1.5 on the basis of a relatively model–independent analysis utilizing 25 separate measurements of the O VIII to Ne IX resonance line ratio. The stated uncertainty includes

random and possible systematic experimental error in the data but does not include possible error in the claculated flux ratios which have been fitted to the observations. This abundance ratio is smaller than most published results based upon EUV or X-ray observations but is in good agreement with direct measurements of flare cosmic rays. (auth)

26796 FORBIDDEN-LINE EXCITATION DATA FOR CERTAIN CORONAL LINES. Czyzak, S.J. (Astronomy Department, Ohio State University); Aller, L.H.; Euwema, R.N. Astrophys. J. Suppl. Ser. 28: No. 272, 465-470 (Dec 1974).

Some new data pertinent to forbidden transitions for coronal lines of S XII, Ca XIII, K XI, Mn XIII, Fe XIV, Co XV, Ni XVI, N XV, Cr IX, Fe X, and Ni XII are presented. (auth)

26797 RAINFALL, DROUGHT, AND THE SOLAR CYCLE. Wood, C. C.; Lovett, R. R. (Addis Ababa Univ., Ethiopia). Nature (London); 251: No. 5476, 594-596(18 Oct 1974).

It has been found that at Addis Ababa the 11 year solar cycle appears to have a greater influence on rainfall variations, and hence drought, than do long term weather cycles. Comparisons are shown of annual rainfall with Zurich sunspot number; the rainfall clearly follows a cyclic pattern in which rainfall peaks and troughs precede the sunspot peaks and troughs by a few years. There is also some evidence that the rainfall/solar cycle relationships observed at Addis Ababa have applied for the past few hundred years over highland Ethiopia as a whole. An intensive study of Indian monsoon rains, based on 50 year records, has also indicated significant correlations with solar cycles. If this sunspot-rainfall relationship is substantiated by data from other stations in the Sahel and India, governments and relief organizations will have a valuable warning of periods of the greatest drought danger. (UK)

26798 NEW SOLAR: TERRESTRIAL RELATIONSHIP. Brown, G. M. (University Coll. of Wales, Aberystwyth, Eng.). Nature (London); 251: No. 5476, 592-594(18 Oct 1974).

Recent suggestions of interrelationships between solar activity, the Earth's magnetic field and the weather are discussed, including the importance of having a reliable method of predicting sunspot activity. Some new solar-terrestrial weather relationships are found. (UK)

26799 EXCESS ^{26}Mg IN THE ALLENDE METEORITE. Gray, C. M. (La Trobe Univ., Bundoora, Australia); Compston, W. Nature (London); 251: No. 5475, 495-497(11 Oct 1974).

It is stated that variations in the isotopic abundance of Mg in meteorites are interesting on account of the possible addition of radiogenic ^{26}Mg by the decay of ^{26}Al. This short-lived nuclide of half-life 7.4×10^5 yr. is formed by proton bombardment of light elements and is of interest in theories of nucleosynthesis and heat generation during the early history of the solar system. In previous studies feldspars from basaltic achondrites and metamorphosed chondrites have been used as analytical material, and there was no finding of excess ^{26}Mg in such meteorites. This is stated not to be surprising, however, since the condensation of chondritic material from the solar nebula appears to predate its later metamorphism by ~80 Myr, and the magnetic activity that produced the basaltic achondrites is younger still. Thus the feldspars formed as a result of these processes would incorporate Al separated from a nucleo-synthetic event by at least 80 Myr, and because of its short half-life insufficient ^{26}Al would remain to generate a detectable ^{26}Mg anomaly. A new possibility is here suggested for the generation of Mg isotope anomalies, arising from the discovery of excess of ^{16}O in the Allende meteorite by Clayton and others (Science 182: 485 (1973)) and their prediction of possible excess of ^{24}Mg derived from stellar nucleosynthesis; also the Ca-Al-rich chondrules in the Allende are considered to be promising candidates in a search for radiogenic ^{26}Mg. Reasons for variations in the isotopic composition of Mg are discussed. An analysis is described of some Allende inclusions and the results are discussed. Amongst conclusions reached is that Mg anomalies may result entirely from excess ^{26}Mg and that this strongly implies an origin by radioactive decay of ^{26}Al formed during intense proton irradiation in the early stages of the solar system. Since the ^{26}Al must have been formed within the solar system because of its short half-life, it is likely that the excess ^{16}O in the Allende, and also some other short-lived nuclides were formed within the solar system. (UK)

26800 DYNAMIC PROCESSES IN THE SOLAR CORONA ON JUNE 30, 1973. Vsekhsvyatskii, S. K.; Dzyubenko, N. I.; Koutchmy, S.; Nesmyanovich, A. T.; Rubo, G. A. (Kiev State Univ.). Dokl. Akad. Nauk SSSR; 218: No. 4, 786-790(1 Oct 1974). (In Russian).

During the eclipse of June 30, 1973, the following processes were observed in the solar corona during the course of an hour: formation and decay (or substantial change of luminosity) of separate formations of medium-scale polar beams, coronal jets, etc., formation and decay of sharp boundaries in the coronal structure of the tangential explosion type, substantial displacement of the boundary of the coronal structure with an average velocity of several km/sec and changes of the direction and curvature of coronal streamers, and separation of the bunches of coronal plasma and their escape from the Sun. (JSR)

26801 METODY ZVEZDNOI STATISTIKI. (Methods of Stellar Statistics). Joeveer, M. Tartu; Tartu Astrophysical Observatory (1974). 50p.

Separate abstracts were prepared for the three papers included. (WDM)

For abstracts of individual papers see: 26681-26683.

26802 EXPERIMENTAL OSCILLATOR STRENGTHS OF WEAK FeI LINES. May, M.; Richter, J.; Wichelmann, J. (Univ., Kiel). Astron. Astrophys., Suppl. Ser.; 18: No. 3, 405-426(Dec 1974).

More than 1000 FeI oscillator strengths were determined from the emission of a low current arc, which was investigated in a previous work. The oscillator strengths were put on the wall-stabilized arc scale of Bridges (1973), which, in turn, is based on various atomic lifetime and branching ratio experiments. Bridges and this list of lines contain 57 common lines having upper excitation potentials between 5 and 7 eV. (auth)

26803 REPEATED GENERATION OF SOLAR COSMIC RAYS ON AUGUST 4, 1972, ACCORDING TO MEASUREMENTS WITH THE PROGNOZ SATELLITES. Volodichev, N. N.; Grigorov, N. L.; Kolesov, G. Ya.; Likin, O. B.; Morozov, E. I.; Pisarenko, N. F.; Savenko, I. A.; Suslov, A. A.; Ustinovshchikov, V. M. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 3, 443-445(1974).

Translated from Kosm. Issled.; 12: No. 3, 483-485(1974).

Two of the strongest chromospheric flares during the current solar-activity cycle occurred on August 4 and 7, 1972. Charged particles of relativistic energy were generated during these events. Data are reported on the initial phase of the rise in cosmic-ray intensity on August 4 and 7, as obtained with equipment carried by the Prognoz 1 and 2 satellites. These results may help to explain some matters concerning the chronological sequence of the August events and the phase of cosmic-ray generation on the Sun. (WDM)

26804 STUDY OF SOLAR PLASMA NEAR MARS AND ON THE EARTH-MARS ROUTE USING CHARGED-PARTICLE TRAPS ON SOVIET SPACECRAFT IN 1971 TO 1973. I. Methods and Instruments. Gringauz, K. I.; Bezrukikh, V. V.; Volkov, G. I.; Verigin, M. I.; Davitaev, L. N.; Kopylov, V. F.; Musatov, L. S.; Sluchenkov, G. F. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 3, 394-402(1974).

Translated from Kosm. Issled.; 12: No. 3, 430-439(1974).

Experiments, which were placed with the help of six spacecraft launched in 1971 and 1973, on the study by probe methods of the plasma near Mars and on the Earth-Mars route are described. A description of the apparatus is presented: modulation ion traps and electron traps having retarding potentials. The characteristics of plasma measurements on oriented spacecraft are considered. The results of laboratory studies of the instruments and examples of the preliminary results of measurements conducted on board the spacecraft are presented. (auth)

26805 EVIDENCE OF SOLAR BURSTS DIRECTIVITY AT 169 MHz FROM SIMULTANEOUS GROUND BASED AND DEEP SPACE OBSERVATIONS (STEREO-1 PRELIMINARY RESULTS). Caroubalos, C.; Steinberg, J. L. (Observatoire de Meudon, France). Astron. Astrophys.; 32: No. 3, 245-253(May 1974).

The STEREO-1 experiment was designed to detect and measure the directivity of solar burst radiation at 169 MHz by simultaneous observations from Nançay (France) and the Soviet planetary probe Mars-3. The equipments are described, the data reduction procedure is analyzed in detail and the errors involved evaluated. A preliminary account of the observations is given. Type I burst radiation is found strongly directive while Type III emission shows much less directivity except for limb events. It is concluded that the experiment provides the first unambiguous evidence of beaming of solar burst radiation in the corona. (auth)

26806 DIRECTIVITY OF TYPE III BURSTS. Caroubalos, C.; Poquerusse, M.; Steinberg, J. L. (Observatoire de Meudon, France). Astron. Astrophys.; 32: No. 3, 255-267(May 1974).

Simultaneous observations of Type III bursts at 169 MHz from the earth and the Soviet planetary probe Mars-3 are reported. Four days were selected: three when active centers were far from the limb; one, November 14, 1971 with an active center near the East limb. (WDM)

Galaxies

Refer also to abstracts 26604, 26658, 26673, 26850, and 26976.

26807 SPIRAL STRUCTURE AND GALACTIC GAMMA RADIATION. Schlickeiser, R.; Thielheim, K. O. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik). Phys. Lett., B; 53: No. 4, 369-372(23 Dec 1974).

The intensity of high-energy galactic gamma rays is calculated using a model for the distribution of interstellar hydrogen and cosmic ray gas coupled through the interstellar magnetic field. Results are compared with recent empirical data from SAS-2. (auth)

26808 IONIZATION OF INTERSTELLAR MATTER BY SUPRATHERMAL DUST GRAINS. Hayakawa, S. (Nagoya Univ. (Japan). Dept. of Physics). Astrophys. Space Sci.; 31: No. 2, L13-L14(Dec 1974).

Suprathermal dust grains as suggested by Wickramasinghe produce electrons of energies not higher than 20 eV by Coulomb collisions with free electrons in an interstellar medium. These electrons are responsible for the production of singly ionized ions but not effective for that of highly ionized ones. This explains a general feature of the composition of atoms and ions as observed from the Copernicus satellite. (auth)

26809 A MODEL FOR CONTINUOUS CLUSTERING IN THE LARGE-SCALE DISTRIBUTION OF MATTER. Peebles, P. J. E. (California Univ., Berkeley (USA). Dept. of Physics). Astrophys. Space Sci.; 31: No. 2, 403-410(Dec 1974).

A new view of the nature of the large-scale distribution of matter is suggested by the fact that the covariance function for the distribution varies smoothly, like a power law, over a wide range of separations. This leads one to ask whether superclusters are entities distinguishable in some natural and fundamental way from clusters, or from groups, or even from individual galaxies. An attempt to find an acceptable model for clustering consistent with the picture of a continuous hierarchy is discussed. (auth)

26810 THE INFRARED BANDS OF SMALL SILICATE SPHEROIDS. Morgan, D. H.; Nandy, K. (Royal Observatory, Edinburgh (UK)). Astrophys. Space Sci.; 31: No. 2, 411-416(Dec 1974).

The effects of the size, shape, and alignment of small silicate spheroids on the wavelength positions of their absorption bands near 10 μm and 20 μm have been investigated. These particles are believed to be a major constituent of interstellar grains and are reported to have been observed in circumstellar dust shells. It is found that the bands for spheroids can be displaced by ~1 μm towards longer wavelengths from their positions for corresponding spheres; and that a further, though smaller, displacement can be superimposed upon this by their subsequent alignment. (auth)

26811 ON THE NONLINEAR TIME DEVELOPMENT OF GAS FLOW IN SPIRAL DENSITY WAVES. Woodward, P.R. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. 195: No. 1, 61-73 (1 Jan 1975).

Time-dependent calculations of the interstellar gas flow in a tightly wound spiral density wave have been performed. The gravitational potential of the gas is ignored, and the flow development is driven by the gravitational potential of the stars. For sufficiently large wave amplitudes, shocks form within one or two transits of the gas through the spiral pattern. The mechanism for steepening of the wave form is discussed by analyzing the roles played by terms in the flow equations as the flow develops. The dependence of the final, steady flow upon the wave amplitude is also investigated. The behavior of the flow is discussed for various pattern speeds in the context of ultraharmonic resonance. Because of the numerical viscosity, only a resonance of the second harmonic component is found, and no secondary shocks develop. Thus, unless self-gravity of the gas is important, explanation of the spiral arm spurs in terms of ultraharmonic resonance is not possible if the gas has turbulence on scales of several parsecs (corresponding to the scale of the mesh spacing). (auth)

26812 A MOLECULAR CLOUD IN IC 1396. Loren, R.B.; Peters, W.L.; Vanden Bout, P.A. (Electrical Engineering Research Laboratory). Astrophys. J. 195: No. 1, 75-79 (1 Jan 1975).

Observations of the large cometary nebula in IC 1396 show it to be a strong source of molecular line emission. The $^{12}C^{16}O$ and $^{13}C^{16}O$ ($J=1-0$) line intensities have been mapped and are well correlated with the optical appearance of the cloud. Emission from SO, HCN, and CS has been detected at the position of peak CO line intensity. Analysis of the CO line intensity maps reveals differing distributions of CO excitation temperature and column density. A heating source is required for the cloud, and a search for an infrared source is suggested. (auth)

26813 FORMATION OF MOLECULES ON SMALL INTERSTELLAR GRAINS. Allen, M.; Robinson, G.W. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology). Astrophys. J. 195: No. 1, 81-90 (1 Jan 1975).

A model is proposed for the formation of molecules on small (radius $\lesssim 0.04$ μ) interstellar grains. It is suggested that the energy liberated when a chemical bond is formed between two atoms on a grain is transferred to the lattice vibrations of the grain, heating up the grain. The "hot" grain, during the time that it is radiatively recooling, may then liberate its adsorbed volatiles. The time scales for molecular desorption from a grain are calculated for OH and CO for four different grain compositions. The results provide some tentative explanations of astronomical observations. (auth)

26814 MASER RADIOMETER OBSERVATIONS OF WATER VAPOR AND OH IN WEAK GALACTIC OH SOURCES. Yngvesson, K.S.; Cardiasmenos, A.G.; Shanley, J.F. (Department of Electrical and Computer Engineering, University of Massachusetts, Amherst); Rydbeck, O.E.H.; Elldér, J. Astrophys. J. 195: No. 1, 91-99 (1 Jan 1975).

Observations of water vapor and ground-state hydroxyl lines in weak galactic OH sources were performed with maser-equipped radio telescopes at the NEROC Haystack Observatory and Onsala Space Observatory, Sweden, respectively. In general, the weak sources exhibit simpler spectra than the strong sources, and detailed correlation studies are facilitated. New water vapor sources have been detected in W37, W43 N, NGC 2438, and ON-3. W12 and W37 are examples of sources in which H_2O masses while OH is seen only in absorption. In other sources, e.g., W31 and W43 N, the velocities of H_2O and OH correlate well. Interferometer measurements of the positions of these fairly weak H_2O sources are required for further correlation between OH and H_2O. (auth)

26815 A HIGH-RESOLUTION NEUTRAL-HYDROGEN STUDY OF THE GALAXY M81. Gottesman, S.T. (Department of Physics and Astronomy, University of Florida, Gainesville); Weliachew, L. Astrophys. J. 195: No. 1, 23-45 (1 Jan 1975).

A 2' synthesis of M81 (NGC 3031) has been made in the 21-cm neutral-hydrogen emission line. In addition to the interferometric data, a single-dish measurement provided information about the large-scale structure. One-third of the H I observed appears to be divorced from the main body of the galaxy and shows large noncircular motions. The satellite system DDO 66/Ho IX has been observed with an indicative total mass of 5×10^9 $M_\odot$ of which 10-20 percent is H I, assuming a distance of 3.25 Mpc to M81. The neutral-hydrogen content of this dwarf irregular galaxy is very high for its luminosity when compared with normal galaxies. The diffuse ring located north of M81 and first noted by Arp has $\sim 1.2 \times 10^9$ $M_\odot$ of H I associated with it. The line-of-sight velocities in this feature are totally inconsistent with rotation in the main plane of M81. A rotation curve was established for M81, and within 20 kpc of the center a mass of 1.1×10^{11} $M_\odot$ is found. The neutral-hydrogen mass in M81 is 4.9×10^9 $M_\odot$. The disk of M81 shows strong noncircular motion in the vicinity of DDO 66/Ho IX. The spiral arms of the galaxy are resolved with a width of ~ 2kpc at a radial distance of 7-10 kpc from the center. In the same region the intrinsic contrast of the gas density of the arms is 3:1-5:1. Employing our new result, a density-wave model is discussed which appears to be in better agreement with the structure of the galaxy than the model using older optical data proposed by Shu *et al.* The kinematics of M81, as derived from our study, do not show the systematic pattern of noncircular velocities expected from the density-wave theory. However, the magnitude of these noncircular terms expected from our density-wave model are too small to be detected where the H I arms are well resolved. (auth)

26816 SOURCES OF EXCITATION OF THE INTERSTELLAR GAS AND GALACTIC STRUCTURE. Cowan, J.J. (Astronomy Program, University of Maryland, College Park); Kafatos, M.; Rose, W.K. Astrophys. J. 195: No. 1, 47-51 (1 Jan 1975).

The excitation of the interstellar gas is discussed in the light of recent evidence from γ-ray, molecular, and 21-cm line observations. Previous studies of the excitation of the interstellar gas have not taken into account the substantial density contrast that exists between spiral arms and interarm regions. We examine the role played by the galactic distribution of three sources of excitation (supernovae, OB stars, and ultraviolet stars) in determining the physical state of the interstellar gas in arm and interarm regions. (auth)

26817 THE VELOCITY FIELD OF THE STARS AND GAS IN NGC 2903. Simkin, S.M. (Department of Astronomy, Columbia University). Astrophys. J. 195: No. 2, 293-313 (15 Jan 1975).

Detailed velocities are reported for the ionized gas and the stars contributing to the H10 absorption line in NGC 2903. Large, noncircular velocities and radial streaming motions are found in both the gas the stars. These seem to be associated with the spiral arms. The position angle of the line of nodes and orientation of this object are established, and its systemic velocity is discussed. (auth)

26818 THE DIFFUSE INTERSTELLAR FEATURES STUDIED IN HD 21389 BY POLARIMETRY AND SPECTROPHOTOMETRY. Martin, P.G. (David Dunlap Observatory and Scarborough College, University of Toronto); Angel, J.R.P. Astrophys. J. 195: No. 2, 379-383 (15 Jan 1975).

If the diffuse interstellar features originate in grains which cause interstellar polarization, then a polarization change proportional to the change in optical depth at the feature is expected. HD 21389 was chosen as an optimum candidate for a polarization study of the λ4430 and λ6284 diffuse features, because of its strong interstellar polarization and diffuse features and because of the reported blue emission wing at λ4430. Such an emission wing is expected if the diffuse features are associated with the interstellar grains which cause continuous polarization and extinction at optical wavelengths. No polarization structure was found at a level much lower than predicted. Subsequent observations do not show a blue emission wing either. While a consistent explanation of these observations in terms of small, poorly aligned grains is possible, we suggest that a molecular or atomic origin for the features is more attractive. (auth)

26819 THE CHEMICAL COMPOSITION OF SELECTED H II REGIONS IN THE MAGELLANIC CLOUDS. Dufour, R.J. (Washburn Observatory, University of Wisconsin—Madison). Astrophys. J. 195: No. 2, 315-332 (15 Jan 1975).

The results of an investigation of the optical spectra of three SMC and 11 LMC H II regions are presented. From the emission-line strengths corrected for interstellar reddening, the relative abundances of H, He, N, O, Ne, S, Cl, and Ar are calculated. The effects of temperature and density fluctuations on the abundance results are also discussed. No substantial abundance variation, or gradient, is found among the observed H II regions in each Cloud. Relative to H, the abundances of the elements heavier than He are found to be lower than in nearby galactic H II regions, such as the Orion Nebula. The lower abundances are generally more pronounced for the SMC H II regions. Of the elements considered, N shows the greatest relative deficiency in the H II regions of both Clouds. (auth)

26820 NEW APPLICATIONS OF THE EQUATIONS OF STELLAR HYDRODYNAMICS. Vandervoort, P.O. (Department of Astronomy and Astrophysics, University of Chicago). Astrophys. J. 195: No. 2, 333-341 (15 Jan 1975).

For a subsystem of stars in an axisymmetric galaxy in equilibrium, the equations of stellar hydrodynamics are extended to include equations involving the third and fourth moments of the velocity distribution; and the extended system of equations is combined with certain auxiliary relations derived from an approximate solution of Liouville's equation for the distribution of stars in the six-dimensional phase space. Formulae are derived which enable the determination of the curvature in the law of galactic rotation and a characteristic scale length of galactic structure parallel to the galactic plane from a knowledge of the velocity of galactic rotation, the slope in the law of rotation, and the moments of the velocity distribution. When supplemented with considerations bearing on the stability of the galactic disk, these formulae provide a practical basis for an approximate determination of the gradients of the density and velocity dispersion of the common stars in the solar neighborhood. Accordingly, the asymmetric drift of the common stars can be determined by inverting the conventional application of the standard hydrodynamic equations. (auth)

26821 THE THIRD AND FOURTH MOMENTS OF THE LOCAL STELLAR VELOCITY DISTRIBUTION. Erickson, R.R. (Department of Astronomy and Astrophysics, University of Chicago, Yerkes Observatory). Astrophys. J. 195: No. 2, 343-358 (15 Jan 1975).

The velocity moments through the fourth order were calculated for a sample of 870 nearby stars chosen to be representative of the common stars of the galactic disk. The moment variances and covariances were also calculated, taking into account both the size of the sample of stars and the observational errors in the data. A number of the moments were found to be significantly larger than the square roots of their variances, indicating that moments as high as the fourth order can be determined with reasonable accuracy. Furthermore, the moments are generally consistent with the symmetries usually assumed for the Galaxy; the moments which exceed their errors are, with two exceptions, the ones expected to be nonzero, while those which are smaller than their errors are the ones predicted to be zero. The structure of the Galaxy was investigated by utilizing the moments in a hydrodynamic model to evaluate such parameters as the curvature in the law of rotation, the gradient in the galactic plane of the number density, the gradient in the galactic plane of the velocity dispersion in the galactic radial direction, and the asymmetric drift. (auth)

26822 RADIATIVE TRAPPING AND HYPERFINE STRUCTURE: HCN. Kwan, J. (Institute for Advanced Study); Scoville, N. Astrophys. J. Lett. 195: No. 2, L85-L88 (15 Jan 1975).

The anomalous weakness of the $F=1\rightarrow1$ hyperfine component in the $J=1\rightarrow0$ emission of interstellar HCN can be caused by radiative trapping in the $J=2\rightarrow1$ lines. The anomaly is readily produced if the $J=1$ levels are populated largely by collisional excitation from $J=0$ to $J=2$ followed by radiative decay to $J=1$ with the $J=2\rightarrow1$ lines optically thick. Regions where the anomaly is found probably have H_2 densities less than 10^5 cm^{-3} and optical depths in the $J=1\rightarrow0$ lines greater than 50. (auth)

26823 THE VISIBLE PHOTODISSOCIATION SPECTRUM OF IONIZED METHANE. Ensberg, E.S.; Jefferts, K.B. (Bell Laboratories, Murray Hill, New Jersey). Astrophys. J. Lett. 195: No. 2, L89-L91 (15 Jan 1975).

Photodissociation of CH_4^+, observed as a decrease in population in a Paul ion trap, occurs with a cross section of the order of 10^{-19} cm^2, decreasing monotonically with wavelength from 3600 Å to 6000 Å. Any predissociative structure is smaller than about 2×10^{-20} cm^2. These results offer no evidence to support Herzberg's suggestion that predissociative absorption in CH_4^+ may be responsible for diffuse interstellar lines. (auth)

26824 ANOMALIES IN THE 18-CENTIMETER OH LINES IN THE GALAXY NGC 4945. Whiteoak, J.B.; Gardner, F.F. (Division of Radiophysics, CSIRO, Sydney, Australia). Astrophys. J. Lett. 195: No. 2, L81-L84 (15 Jan 1975).

The OH clouds in the central regions of NGC 4945 produce anomalous emission and absorption features in the satellite-line profiles at 1612 and 1720 MHz. The anomalies are consistent with perturbations of the relative populations of the $F=1$ and $F=2$ hyperfine levels of the ground state of OH, which could be caused by infrared pumping. (auth)

26825 CARBON MONOXIDE OBSERVATIONS OF A DUST CLOUD IN THE ORION REGION: L1630. Milman, A.S.; Knapp, G.R.; Kerr, F.J.; Knapp, S.L. (University of Maryland, College Park, Maryland); Wilson, W.J. Astron. J. 80: No. 2, 93-100 (Feb 1975).

We have observed the $J = 1-0$ rotational transitions of $^{12}C^{16}O$ and $^{13}C^{16}O$ at 115 and 110 GHz in the dust cloud L1630, in the Orion region. L1630 contains several reflection nebulae, the Horsehead nebula, and many young stars. The CO emission is strongest at the positions of the reflection nebulae NGC 2023 and NGC 2068, and may be enhanced near individual young stars. The shapes of the ^{12}CO and ^{13}CO profiles provide evidence that the excitation temperature of the ^{12}CO line is different at different radial velocities. The possibility that the excitation temperature of the ^{13}CO line is smaller than that of the ^{12}CO line is discussed. If this is so, we can only calculate a lower limit to the ^{13}CO optical depth, and an upper limit to the CO column density. Two alternative models that involve turbulent motions of the gas are briefly explored. (auth)

26826 CARBON MONOXIDE OBSERVATIONS OF 34 DUST CLOUDS. Milman, A.S.; Knapp, G.R.; Knapp, S.L. (University of Maryland, College Park, Maryland); Wilson, W.J. Astron. J. 80: No. 2, 101-110 (Feb 1975).

We have made observations in the $J = 1-0$ rotational lines of $^{12}C^{16}O$ and $^{13}C^{16}O$ in the directions of 34 dust clouds. ^{12}CO emission was detected from 26 of these dust clouds; no ^{12}CO emission was seen in the directions away from dust clouds. The ^{12}CO and ^{13}CO profiles are presented for all the positions where we have observations of both lines. The CO excitation temperatures, column densities, and the ^{13}CO optical depths are discussed; we conclude that, in most of the clouds we observed, the ^{13}CO line probably has a moderate optical depth, and the neutral-particle density is probably smaller than that necessary to thermalize the $J = 0$ and $J = 1$ levels of CO collisionally. We have found that the CO emission is often enhanced near young stars embedded in dust clouds. (auth)

26827 STUDY OF GALACTIC GAS AND DUST USING OBSERVATIONS OF ELLIPTICAL GALAXIES. Knapp, G.R. (Owens Valley Radio Observatory, California Institute of Technology, Pasadena, California 91125). Astron. J. 80: No. 2, 111-116 (Feb 1975).

The gas-to-dust ratio has been measured in the directions of 55 elliptical galaxies by comparing 21-cm H I column densities with color excesses and absorptions for the galaxies. The value of the gas-to-dust ratio found in this study is similar to previous measurements, but the data suggest significant small-scale structure of the interstellar medium. (auth)

26828 CONTINUUM RADIO STRUCTURE OF THE GALACTIC DISK. Price, R. M. (Massachusetts Inst. of Tech., Cambridge). Astron. Astrophys.; 33: No. 1, 33-38(Jun 1974).

An analysis of the 150 MHz continuum profile along the galactic equator suggests that the nonthermal radio emission of the disk has two major components, a base disk and a spiral component. Each contributes approximately one-half of the observed brightness at 150 MHz. The volume emissivity of the base disk decreases with increasing distance from the galactic center. The spiral features have volume emissivities that are at least four times the value of the base disk in the same region. The results of the model suggest that the Sun is near the inner edge of a nonthermal spiral feature. If the Sun is just within such a feature, the local increase in volume emissivity explains the observed brightness at high galactic latitudes and there is no need for a radio halo. (auth)

26829 GAS KINEMATICS NEAR THE GALACTIC CENTER FROM CO OBSERVATIONS. Sanders, R. H. (National Radio Astronomy Observatory, Charlottesville, VA); Wrixon, G. T. Astron. Astrophys.; 33: No. 1, 9-14(Jun 1974).

A fine grid 2.6 mm CO line survey of a small region near the galactic center has been carried out with the 36' antenna of the NRAO. The survey at b = 00°00' covers the longitude range 359°50' < l < 00°10' and the velocity range −238 km s^{-1} < V < 238 km s^{-1}. Observations were made every one minute of arc in longitude with a one arch minute beam. The results are displayed in the form of a longitude velocity contour map of antenna temperature. Considerable spacial structure in the CO emission at the level of a few minutes of arc is observed. Three distinct features with significant noncircular velocity are noted. Two of these features with noncircular velocities of −35 km s^{-1} and −53 km s^{-1}, have been detected previously in neutral hydrogen and formaldehyde, but the third, at 165 km s^{-1} has not previously been detected in any other emission or absorption component. The brightest CO emission components have line-of-sight velocities which are permitted in the sense of galactic rotation and a significant velocity gradient in the same sense. This suggests that these components arise from regions within 10 to 100 pc from the center. A model of the spatial distribution of CO emitting regions which explains the bright emission components is presented. (auth)

26830 SPECTROSCOPIC STUDY OF SOME COMPACT GALAXIES. Carozzi, N.; Chamaraux, P.; Duflot, R. (Observatoire, Marseille). Astron. Astrophys.; 33: No. 1, 113-116 (Jun 1974). (In French).

The spectra of fourteen compact blue galaxies were recorded with a RCA C 33011 image tube attached to the E spectrograph at the Observatory of Haute Provence. Seven of them have absorption lines and five show emission lines. As far as possible radial velocities and intensities of some lines have been measured. Hubble diagram is drawn for all the compacts studied and Barbon's ones. In spite of difficulties of measuring, one can see that the corresponding points are located between normal galaxies and QSS. (auth)

26831 PARKER INSTABILITY IN DIFFERENTIALLY-ROTATING DISKS. Shu, F. H. (Univ. Groningen, Ger.). Astron. Astrophys.; 33: No. 1, 55-72(Jun 1972).

Parker's instability for a differentially rotating system comprised of thermal gas, magnetic field, and cosmic-ray particles was investigated. The rotation axis coincides with the direction of the vertical gravity, and the rotation is modelled to occur with linear shear. The general initial-value problem is formulated, and the condition for normal modes is obtained from this formulation. A dispersion relation is obtained for the limiting case when the growth rate (or frequency) of the wave is large in comparison with the kinematic shear rate. This dispersion relation suffices to show, in the absence of dissipation, that no finite amount of shear and rotation can ever completely stabilize Parker's mode although the growth rate of certain Fourier components can be materially reduced. Eigenvalues and eigenfunctions are computed analytically for a number of limiting cases of interest, and a few numerical examples are given. The effect of rotation is to suppress waves which are very long in the horizontal directions; the full effects of shear are more difficult to assess—numerical methods are suggested for future work. Subsidiary issues examined in this study are (i) the derivation of an alternative equation, valid in the nonlinear regime and for arbitrary geometries, for the usual fluid equation adopted to describe the behavior of the cosmic-ray pressure, (ii) the distinction between environments under which Parker's mode of instability is likely to lead to convection, to cosmic-ray inflation, or to gas drainage downward to form dense clumps of matter, (iii) an explanation of the physical reasonableness of normal mode solutions with finite energy densities at infinity and the relation of such solutions to the initial-value problem. (auth)

26832 FORMATION OF INTERSTELLAR CLOUD COMPLEXES, OB ASSOCIATIONS, AND GIANT H II REGIONS. Mouschovias, T. Ch.; Shu, F. H.; Woodward, P. R. (Univ. of California, Berkeley). Astron. Astrophys.; 33: No. 1, 73-77 (Jun 1974).

It is proposed that large cloud complexes, OB associations, and giant H II regions form as a result of the initiation of the magnetic Rayleigh–Taylor instability in the interstellar medium by the passage of a galactic shock. Total masses of about 10^6 $M_\odot$, formation of unbound systems, and alignment along spiral arms with typical separation of about 1 kpc are natural consequences of this point of view. In addition, it is argued that the enhancement of synchrotron radiation to be expected in the compression zones of spiral galaxies has hitherto been considerably overestimated. (auth)

26833 TECHNIQUE FOR THE REDUCTION OF NEBULAR LINE PROFILES OBSERVED WITH PHOTOELECTRIC FABRY–PEROT MONOCHROMATORS. Dopita, M. A. (Manchester Univ., Eng.). Astron. Astrophys.; 33: No. 1, 147-150(Jun 1974).

A method is given for deriving temperatures of nebulae by Fourier analysis of an observed hydrogen line profile and that of a forbidden line of a heavier element. This is a factor of two hundred times faster than the convolution and fitting technique used hitherto. (auth)

26834 OB STARS DETECTION IN THE LMC. Martin, N. (Observatoire, Marseille); Rousseau, J. Astron. Astrophys.; 33: No. 1, 135-138(Jun 1974). (In French).

A previously described method was used to continue the very hot stars detection in LMC. More than 250 new O–B2 stars were detected and 400 Sanduleak stars were classified. Among them, about 200 stars are O–B2 stars. A color–color diagram, and the stars position on the LMC chart show the main points of the results. This result corroborates the uv chart and completes the LMC structure. (auth)

26835 OBSERVATIONS OF THE ORION NEBULA AT 100 μm. Ward, D. B.; Harwit, M. (Cornell Univ., Ithaca, NY). Nature (London); 252: No. 5478, 27(1 Nov 1974).

Observations of the Orion Nebula, at coarse spectral resolution, were made in March 1974 using a cooled grating spectrometer carried on a jet aircraft. The instrument covered the spectral range from 80 to 125 μm at a resolution of 8 μm, and used a Ga:Ge photoconductive detector. The field of view was large enough to include most of the brighter parts of the Orion 100 μm source. The spectrum, corrected for atmospheric water vapour absorption, is shown. It was concluded that the results were consistent with a thermal emission spectrum produced by cool interstellar grains radiating at a wavelength much longer than the grain size. (UK)

26836 INTERSTELLAR DEUTERIUM. Barrett, A. H. (Massachusetts Inst. of Tech., Cambridge). Comments At. Mol. Phys.; 4: No. 4, 93-96(Jul 1973).

Interstellar deuterium has been detected in the molecule DCN, by virtue of its microwave spectrum, and in HD by virtue of its ultraviolet spectrum. The interpretation of the results in terms of an interstellar D/H abundance ratio is complicated by the effects of saturation, unequal binding energies, and shielding within the interstellar clouds. (9 references). (auth)

26837 HELIUM ABUNDANCE IN GALACTIC H II REGIONS. Churchwell, E.; Mezger, P. G. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 32: No. 3, 283-308(May 1974).

Observations are presented of He and H radio recombination lines of 39 galactic H II regions, most of which require ionization by stars of spectral type O9 or earlier. Values were obtained for the abundance of ionized He in the range $0.06 \leqq \langle N(He^+)/N(H^+)\rangle \leqq 0.10$ for spiral arm H II regions and $\langle N(He^+)/N(H^+)\rangle \leqq 0.02$ for three giant H II regions in the galactic center, while the abundance of doubly ionized He, $\langle N(He^{++})/N(H^+)\rangle < 0.008$. It is suggested that $N(He)/N(H) = y_{Gal} = 0.10$ (mass fraction $Y_{Gal} = 0.28$) is the present abundance of ^4He in the Galaxy. Values of $\langle N(He^+)/N(H^+)\rangle < 0.10$ are attributed to noncoincidence of H^+- and He^+-Strömgren spheres due to selective absorption of the ionizing photons by dust. From a comparison of this value for y_{Gal} with the abundance of ^2H observed in the interstellar gas, and with computations of element production in the standard model of the "big bang", a primeval ^4He-abundance of $y_{Prim} \approx 0.08$ ($Y_{Prim} \approx 0.24$) and an enrichment of the interstellar matter as a result of galactic evolution, of $\Delta Y_{ev} \approx 0.04$ are suggested. (auth)

26838 HETEROCLINIC STELLAR ORBITS AND "WILD" BEHAVIOR IN OUR GALAXY. Martinet, L. (Observatoire de Geneve). Astron. Astrophys.; 32: No. 3, 329-333(May 1974).

The eigencurves are constructed through some hyperbolic fixed points of the phase plane $(\bar{\omega},\hat{\omega})$ for different values of the energy E in the axisymmetric models of the Schmidt galactic potentials. The existence of heteroclinic stellar orbits is proved for small values of the angular momentum J (i.e., J = 200 kms^{-1} kpc, typical value for globular cluster orbits) and the appearance of the "wild" (semi-ergodic) region which arises in the $(\bar{\omega},\hat{\omega})$ plane can be explained by observing how the network of eigencurves related to the unstable 3-, 5-, and 7-periodic orbits evolves as the energy E increases from 130,000 km^2 s^{-2} to 115,000 km^2 s^{-2}. This evolution is connected with that of the "rotation curve" giving the rotation number r as a function of $\bar{\omega}$, in the same range of values of E. Implications for the orbit computation in various models of the galactic potential are indicated. (auth)

26839 CHEMICAL EVOLUTION OF THE GALAXIES. Unsoeld, A. (Univ., Kiel). pp 84-103 of Galaxies and Relativistic Astrophysics. Barbanis, B. (ed.). Berlin; Springer-Verlag (1974).

From first European astronomical meeting on galaxies and relativistic astrophysics; Athens, Greece (4 Sep 1972).

The age of the Galaxy is discussed, taking into account that practically all the heavy elements must have existed at a very early stage of the Galaxy. The most probable value for its age

seems to be indicated by the radioactive elements having no "parents" (about 7 to 8 b.y.). After a brief review of abundances in other galaxies, theories concerning the origin of the heavier elements and their different mixtures with H + He are discussed. The following points are emphasized: (1) production of the heavier elements in the observed uniformity by a variety of different processes in individual stars is highly improbable; (2) the importance of the empirical abundance-rules detected by Suess (1964, 1966) and of pycno-nuclear processes as proposed by Amiet and Zeh (1968) is emphasized; and (3) the luminosity function of old halo stars is shown to be the same as for the corresponding disc stars. It is therefore extremely improbable that the proto-halo had a completely anomalous frequency of massive stars. (auth)

26840 GALAXIES AND RELATIVISTIC ASTROPHYSICS. Proceedings of the First European Astronomical Meeting, Athens, Greece, September 4–9, 1972. Volume 3. Barbanis, B.; Hadjidemetriou, J. D. (eds.). Berlin; Springer-Verlag (1974). 257p. $51.50.

A mass of recent observational data on phenomena in galaxies is reviewed, new galactic theories and cosmological models are surveyed, and the general implications of the new material are considered. Topics include radio work in near galaxies, H I distribution in nearby and external galaxies, compact structures in radio galaxies, optical studies, gas motions in Seyfert galaxy nuclei, the Magellanic clouds, chemical evolution of galaxies, spiral structure and resonances, stellar drift motions, the dynamics of galaxies, stability of stellar masses, Schwarzschild black holes, the stability of nonradial vibrational modes of relativistic neutron stars, relativistic MHD flows, and pulsars. Individual items are announced in this issue. (IAA)

26841 VARIATION OF THE He Nα: H Nα RADIO RECOMBINATION LINE RATIOS AS A FUNCTION OF THE RELATIVE SIZES OF THE He^+ AND H^+ REGIONS DEDUCED FROM A MODEL OF ORION A. Batchelor, A. S. J. (University Coll., London). Astron. Astrophys.; 32: No. 3, 343-348(May 1974).

Calculations have been made with the hydrogen model of Orion A by Brocklehurst and Seaton (1971–1972), as modified to include helium by Batchelor and Brocklehurst (1972), to derive the He nα : H nα radio recombination line ratios for both L.T.E. and non-L.T.E. cases, where the beamsize of the observing telescope and the relative size of the He Strömgren sphere are independently varied. The calculations were performed for telescope beams encompassing the entire model, decreasing in stages to very small pencil beams. The size of the He Strömgren sphere relative to the H Strömgren sphere was varied from coincidence to an almost zero He^+ region. Where the telescope beamsize is large and the He^+ sphere is much smaller than the H^+ sphere (these regions are concentric), the high nα line ratios show large discrepancies between the LTE and non-LTE calculations. For these cases the non-LTE ratios are consistently smaller than the LTE ratio. However, it is also shown that for the low nα lines, e.g., 56α, the LTE and non-LTE cases are in close agreement, as one would expect. (auth)

26842 COMMENTS OF THE PAPER "SHAPES OF NEUTRAL GLOBULES ASSOCIATED WITH DIFFUSE NEBULAE." Dyson, J. E. (Univ. of Manchester, Eng.). Astron. Astrophys.; 32: No. 3, 349-350(May 1974).

The radiation field boundary condition used by Dyson (1973) is reconsidered. A more accurate approximation allows only axially symmetric globules which are also symmetric about their equatorial planes. Globules respond with low surface curvature and high surface density towards maxima in the normal radiation flux incident on the ionized jacket. Conversely they respond with high surface curvature and low surface density towards minima in the normal radiation flux. Fairly large departures from isotropy in the radiation field intensity as seen from the globule surface produce small departures in the globule shape from sphericity. (auth)

26843 RADIAL FLOW FROM THE NUCLEUS OF GALAXY. Bondyopadhaya, R. (Jadavpur Univ., Calcutta). Indian J. Phys.; 48: No. 7, 585-592(Jul 1974).

An expression for radial flow velocity of gaseous materials from the nucleus of the Galaxy was derived. It was found that mainly the gravitational force has the capability of controlling this flow. It is suggested that an accelerating mechanism (most probably nuclear explosion) caused the 3-kpc arm to move. Using the values of different parameters it is concluded that 3-kpc arm started its journey at about 12 million years ago with the velocity 234 km/s., but afterwards mainly due to gravitational pull its velocity has been reduced to 53 km/s at the present time. (auth)

Cosmology

Refer also to abstract 27836.

26844 COSMOLOGICAL DEDUCTIONS FROM THE RELATIVISTIC STABILITY OF CLUSTERS OF GALAXIES. Wesson, P. S. (Cambridge Univ. (UK). Inst. of Theoretical Astronomy). Astrophys. Space Sci.; 31: No. 2, 333-339(Dec 1974).

Clusters of galaxies are approximated by the Schwarzchild interior solution (with nonzero cosmological constant) embedded in a Robertson/Walker background. The conditions that the two metrics join up smoothly and that the cluster be stable imply either (a) $\kappa = -1$ with Λ lying in the range $-1.1 \times 10^{-27} \lesssim \Lambda \lesssim 1.5 \times 10^{-36}$ (s^{-2}), or (b) $\kappa = 0$. Also, superclustering on a scale larger than 0.5 Mpc is unacceptable unless $\Lambda < 0$. (auth)

26845 THE APPLICATION OF A NON-STATIC SPHERICALLY-SYMMETRIC METRIC TO CLUSTERS OF GALAXIES. Wesson, P. S. (Cambridge Univ. (UK). Inst. of Theoretical Astronomy). Astrophys. Space Sci.; 31: No. 2, 341-347(Dec 1974).

An approximate metric is found which represents a sphere of matter embedded in a background of dust. The use of this metric in conjunction with the Friedmann equations gives values of Λ for the three possible values of k as $\Lambda \simeq +6 \times 10^{-36}$ ($k = +1$), $\Lambda \simeq +3 \times 10^{-35}$ ($k = 0$), $\Lambda \sim +10^{-36}$ ($k = -1$). These values depend on data regarding clusters of galaxies, and are probably accurate to within an order of magnitude given the correctness of the assumptions on which their derivation rests. (auth)

26846 THE STABILITY OF SUPERMASSIVE STARS IN THE PARAMETRIZED POST–NEWTONIAN FRAMEWORK. Duncan, M.; Anand, S. P. S. (Toronto Univ., Ontario (Canada)). Astrophys. Space Sci.; 31: No. 2, 295-304(Dec 1974).

The binding energy and stability of supermassive stars (SMS's) are examined in the framework of the Parametrized Post-Newtonian (PPN) formalism of Will and Nordvedt. The PPN formalism encompasses the post-Newtonian limit of virtually every theory of gravity, differentiating between theories by means of nine PPN parameters. A general expression is derived for the energy integral in the PPN framework, and it is found that only in those theories in which the parameters $\xi_1 = \xi_2 = \xi_3 = \xi_4 = \alpha_3 = 0$ will the energy be conserved. In all such theories, a SMS of radius less than a critical radius will be unstable against adiabatic radial perturbations. Present experimental limits on the PPN parameters γ and β do not exclude the possibility of the existence of stable, nonrotating, hydrogen-burning SMS's of masses an order of magnitude larger than the upper limit for the mass of such stars predicted in general relativity. (auth)

26847 SPECTROPHOTOMETRY OF FAINT CLUSTER GALAXIES AND THE HUBBLE DIAGRAM: AN APPROACH TO COSMOLOGY. Gunn, J.E.; Oke, J.B. (Hale Observatories, California Institute of Technology, Carnegie Institution of Washington). Astrophys. J. 195: No. 2, 255-268 (15 Jan 1975).

New spectrophotometric data are presented for large–redshift galaxies in clusters. A new approach to aperture corrections and the analysis of the Hubble diagram is outlined, including the explicit incorporation of evolutionary effects. The importance of selection effects on the usual methods of analysis are in principle overcome in the analysis, although the heterogeneity of the sample still makes conclusions about cosmology slightly suspect. Formal values of the deceleration parameter are derived under several sets of assumptions, yielding results between $q_0 = +0.33$ and $q_0 = -1.27$ with formal standard deviations of order 0.7. (auth)

26848 CYLINDERS AS GRAVITATIONAL RADIATION TELESCOPES. Hier, R.G.; Rasband, S.N. (Department of Physics and Astronomy, Brigham Young University). Astrophys. J. 195: No. 2, 507-512 (15 Jan 1975).

The multitude of resonance modes of a free elastic cylinder are viewed as a host of resonant detectors for gravitational radiation. The absorption cross sections for all modes using exact cylinder eigensolutions are obtained, and detailed numerical results for the axisymmetric longitudinal modes in the Pochhammer–Chree approximation are presented. The combining of information from all modes excited by a gravitational wave pulse to give spectral and directional information about the incident burst is discussed. (auth)

26849 DISTORTIONS OF THE 3 °K BACKGROUND RADIATION SPECTRUM: OBSERVATIONAL CONSTRAINTS ON THE EARLY THERMAL HISTORY OF THE UNIVERSE. Chan, K.L. (Princeton University, Department of Physics); Jones, B.J.T. Astrophys. J. 195: No. 1, 1-11 (1 Jan 1975).

The distortions of the cosmic microwave background radiation spectrum due to heat input prior to recombination is examined analytically and also by direct numerical solution of the time–dependent Kompaneets equation. The analytic approximations are found to be very good over a large range of thermal histories that are compatible with observation. The constraint on the cosmic thermal history imposed by observations of the Rayleigh–Jeans part of the spectrum are reevaluated. (auth)

26850 THE THEORY OF TRANSPARENT GRAVITATIONAL LENSES. Bourassa, R.R.; Kantowski, R. (The University of Oklahoma). Astrophys. J. 195: No. 1, 13-21 (1 Jan 1975).

The theory of transparent gravitational lenses is presented in this paper. All calculations are done within the framework of the linearized Einstein gravitation theory, the geometrical optics approximation, and the small-angle scattering approximation. We present a general expression for the bending angle of a light ray that goes around or through a bounded mass. This expression is used to calculate the locations, intensifications, distortions, orientations, and velocities of image seen around or through such masses. The above formulae are evaluated for deflectors with spheroidal volume mass densities and deflectors with elliptical surface mass densities. A simple volume mass density $\rho \propto 1/a$, is used to illustrate the multiple imaging capabilities of a spheroidal deflector. (auth)

26851 WAS THE BIG BANG A WHIMPER? Ellis, G. F. R. (Boston Univ., Mass. (USA). Dept. of Physics; Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics); King, A. R. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). Commun. Math. Phys.; 38: No. 2, 119-156(Oct 1974).

In many cases the spatially homogeneous cosmological models of General Relativity begin or end at a "big bang", where the density and temperature of the matter in the universe diverge. However, in certain cases the spatially homogeneous development of these universes terminates at a singularity where all physical quantities are well-behaved (a "whimper") and an associated Cauchy horizon. We examine the existence and nature of these singularities, and the possible fate of matter which crosses the Cauchy horizon in such a universe. The nature of both kinds of singularity is illustrated by simple models based on two-dimensional Minkowski space-time; the possibility of other types of singularity occurring is considered. (auth)

26852 VELOCITY OF MAGNETOHYDRODYNAMIC WAVES IN GENERAL RELATIVITY. Mason, D. P. (Univ. of the Witwatersrand, Johannesburg). Gen. Relativity Gravitation; 5: No. 4, 429-439(Aug 1974).

The energy-momentum tensor for a perfect fluid with infinite conductivity is modified slightly by attributing a proper energy content to a field of tension, as proposed by Cattaneo (Relativity and Gravitation. Gordan and Breach, New York p.77 (1971)), for a perfect nonconducting fluid, and it is shown that with this modification the velocities of the hydrodynamic waves in the fluid do not exceed c. This contrasts with the standard theory in which a lower limit must be placed on the compressibility of the fluid to prevent the velocity of the "fast" hydrodynamic wave from exceeding c. The velocity of the Alfvén wave is changed only slightly and is always less than c as in the standard theory. (auth)

26853 DEVELOPMENT OF GENERAL RELATIVITY. Chandrasekhar, S. (Univ. of Chicago). Nature (London); 252: No. 5478, 15-17(1 Nov 1974).

From 1974 annual meeting of the American Physical Society; Chicago, IL (5 Feb 1974).

Reference is made to an account of the history of the development of the general theory of relativity as given by Dyson at a meeting of the American Physical Society in 1965 (see Physics Today, June 1965). Dyson stated that to Einstein and many other physicists of the 1920s it appeared that his theory of gravitation must be the model for the future development of physics, and it was expected that Einstein's theory would lead to understanding of electromagnetism and of matter. These expectations proved false, and matters took an entirely different direction with the advent of quantum mechanics in 1925. The theory of gravitation and general relativity gradually became detached from the rest of physics and was studied only by a few specialists. Interest was, however, renewed during the 1960s, due mainly to new astronomical observations and planned new experiments. Chandrasekhar states that it is not clear to him why some obvious questions were not asked in connection with general relativity until quite recently, questions whose answers could well have contributed to an understanding of the theory itself, as distinct from the bearing on possible observations or experiments. Some examples of such questions are given. These concern firstly precession of the orbits of the planets, and particularly Mercury, and secondly questions concerning the reality of gravitational waves. A third example concerns the Schwarzschild radius. The questions that might have been asked earlier were fully answered during the 1960s in the context of relativistic astrophysics. (UK)

26854 HIGH ENERGY RADIATION FROM WHITE HOLES. Narlikar, J. V.; Rao, K. M. V. A.; Dadhich, N. (Tata Inst. of Fundamental Research, Bombay). Nature (London); 251: No. 5476, 590-591(18 Oct 1974).

A discussion is presented on possible ways in which the concept of "white holes", the time-reversed versions of black holes, may be useful to high energy astrophysics. Basically a "white hole" is an object exploding from a highly dense or a singular state. It may represent a delayed "big bang" in a Friedman universe, or it may be a case of a collapsing object reversing implosion to explosion. In the latter case unconventional equations of state or negative energy fields are required if the theoretical framework is to be fitted into that of general relativity. In the present discussion a "white hole" is considered to be an object exploding from a singularity and subsequently obeying Einstein's gravitation equations. The spectral features to be expected from such a hole are first calculated, followed by a consideration of astrophysical implications. The following assumptions are made: (i) the "white hole" emerges from the singularity as a spherical object of uniform density and zero pressure in the comoving frame of the outward moving particles; (ii) the light emitted is monochromatic and passes radially outwards from the surface at a uniform rate in the comoving reference frame; (iii) the space-time exterior to the object is empty. Matters of interest in high energy astrophysics include the following: (1) the hard electromagnetic radiation from "white holes" at the centres of, say Seyfert galaxies could be a source of background x and γ radiation; (2) the transient nature of x-ray and γ-ray bursts suggests a "white hole" origin; (3) it is possible to think of "white holes" in the Galaxy on the scale of supernovae, yielding high-energy cosmic rays up to the highest observed energy. (UK)

26855 SIGNIFICANCE OF PERIHELION SHIFT CALCULATIONS. Duff, M. J. (International Centre for Theoretical Physics, Trieste, Italy). Gen. Relativity Gravitation; 5: No. 4, 441-452(Aug 1974).

An attempt is made to resolve a confusion which exists in the literature over whether the perihelion precession of planetary orbits is a linear or nonlinear effect. The problem is both one of physics and semantics. (auth)

26856 NEUTRINO RADIATION IN SPHERICALLY-SYMMETRIC GRAVITATIONAL FIELDS. III. Comparison with Photon Radiation Fields. Griffiths, J. B. (Loughborough Univ. of Tech., Eng.). Gen. Relativity Gravitation; 5: No. 4, 453-464(Aug 1974).

The gravitational properties of spherically-symmetric photon and neutrino radiation fields are compared and found to be identical. A model for the photon radiation field made up of incoherent radiation is first developed, equations for photons being required to satisfy Maxwell's equations. (auth)

26857 NEUTRINO RADIATION IN SPHERICALLY-SYMMETRIC GRAVITATIONAL FIELDS. II. The Structure of the Radiation Field. Griffiths, J. B.; Newing, R. A. (Loughborough Univ. of Tech., Eng.). Gen. Relativity Gravitation; 5: No. 3, 345-352 (Jun 1974).

It is shown that the neutrino radiation field emitted by a star may be described by Vaidya's radiating Schwarzschild metric (Curr. Sci. (India); 12: 183 (1943)). The gravitational energy shift of the neutrino field is also considered, both in terms of an exact solution and in the weak field approximation. (auth)

26858 SPECTRUM OF THE COSMIC BACKGROUND RADIATION BETWEEN 3 mm AND 800 μm. Robson, E. I.; Vickers, D. G.; Huizinga, J. S.; Beckman, J. E.; Clegg, P. E. (Queen Mary Coll., London). Nature (London); 251: No. 5476, 591-592 (18 Oct 1974).

An experiment designed to determine the spectrum of the cosmic background radiation from ~3 mm to wavelengths shorter than the Planck peak for a temperature of 2.7K is described. The experiment was launched to an altitude of 40 km in March 1974 from Palestine, Texas, and the results of a preliminary analysis of the data obtained are given. The instrument used was a polarizing Michelson interferometer cooled by a liquid He bath to 1.4°K and the experimental technique is described. A sharp decline was found in the spectral intensity above 6 cm^{-1}, and it would be very difficult to reconcile the observations with a background temperature > about 2.9°K. (UK)

26859 ESO/UPPSALA SURVEY OF THE ESO (B) ATLAS OF THE SOUTHERN SKY. I. Holmberg, E. B. (Uppsala Observatory); Lauberts, A.; Schuster, H. E.; West, R. M. Astron. Astrophys., Suppl. Ser.; 18: No. 3, 463-489(Dec 1974).

A systematic search for certain objects (NGC + IC galaxies with a diameter larger than about 1.0, all distributed galaxies, all star clusters in the Budapest Catalogue, and all listed planetary nebulae) is being carried out by means of the ESO (B) Atlas, covering the southern sky from -90 to -20. The present paper introduces the search procedures and gives lists of objects in the first 20 fields (out of a total of 606). (auth)

26860 ESO/UPPSALA SURVEY OF THE ESO (B) ATLAS OF THE SOUTHERN SKY. II. Holmberg, E. B. (Uppsala Obser-

vatory); Lauberts, A.; Schuster, H. E.; West, R. M. Astron. Astrophys., Suppl. Ser.; 18: No. 3, 491-509(Dec 1974).

A systematic search for certain objects (NGC + IC galaxies, all galaxies with a diameter larger than about 1.0 all disturbed galaxies, all star clusters in the Budapest Catalogue, and all listed planetary nebulae) is being carried out by means of the ESO (B) atlas, covering the southern sky from $-90°$ to $-20°$. The present paper contains the second list of objects in 16 fields. (auth)

26861 FRIEDMANN UNIVERSES CONTAINING WAVE FIELDS. Das, A.; Agrawakl, P. (Simon Fraser Univ., Burnaby, B. C.). Gen. Relativity Gravitation; 5: No. 4, 359-370(Aug 1974).

In this paper the Friedmann universes containing (i) a massless real scalar field, (ii) a massive real scalar field, (iii) electromagnetic fields, (iv) the combined massive complex scalar and electromagnetic fields are investigated. In (i) the field has to be either purely spatial or else purely temporal and the latter case is completely solved. Similarly in (ii) the purely time-dependent case has been reduced to a single fourth order ordinary differential equation. In this case graphs of the numerical solutions have been exhibited. In (iii) as expected, no non-trivial solution exists. In (iv) all possible cases are studied. In case the complex wave function is a product of two non-constant functions, i.e. $\psi = \xi(r)\,\tau(t)$ there exists no solution. In the subcase $\xi(r) = \xi^*(r) =$ constant, $|\tau(t)| =$ constant the problem is completely solved. In the subcase $\xi(r) = \xi^*(r) =$ constant and $|\tau(t)|$ is non-constant, the system of equations reduces to the same fourth order ordinary differential equation as mentioned before. In the last two subcases, the time-dependent wave field carries electric charge density which, strangely enough, is decoupled from the electromagnetic fields. (auth)

26862 GENERALIZED SHEAR-FREE SINGULARITIES. King, A. R. (Cambridge Univ., Eng.). Gen. Relativity Gravitation; 5: No. 4, 371-377(Aug 1974).

The possibility of matter singularities in a class of cosmological models is considered. The results are applied to shear-free models and suggest that in these the fluid cannot simultaneously expand and rotate. (auth)

Planetary Phenomena

Refer also to abstract 27579.

26863 (N-74-28270) MAGNETISM AND THE INTERIOR OF THE MOON. Dyal, P.; Parkin, C. W.; Daily, W. D. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). Feb 1974. 110p. (NASA-TM-X-62354). NTIS $4.50.

The application of lunar magnetic field measurements to the study of properties of the lunar crust and deep interior is reviewed. Following a brief description of lunar magnetometers and the lunar magnetic environment, measurements of lunar remanent fields and their interaction with the solar plasma are discussed. The magnetization induction mode is considered with reference to lunar magnetic permeability and iron abundance calculations. Finally, electrical conductivity and temperature calculations from analyses of poloidal induction, for data taken in both the solar wind and in the geomagnetic tail, are reviewed. (auth)

26864 (N-74-32255) ANALYSIS OF JUPITER DATA FROM THE RAE-1 SATELLITE. Final Report, 1 July 1973–30 September 1974. Carr, T. D. (Florida Univ., Gainesville (USA). Dept. of Physics and Astronomy). Sep 1974. 26p. (NASA-CR-139581). NTIS $4.50.

The analysis of Radio Astronomy Explorer Satellite data are presented. Radio bursts from Jupiter are reported in the frequency range 4700 kHz to 45 kHz. Strong correlation with Io were found at 4700, 3930, and 2200 kHz, while an equally strong Europa effect was observed at 1300, 900, and 700 kHz. Histograms indicating the relative probability and the successful identification of Jupiter activity were plotted, using automatic computer and visual search techniques. (STAR)

26865 RELATIONSHIPS AMONG THE INTERPLANETARY PLASMA PARAMETERS: HEOS 1, DECEMBER 1968 TO DECEMBER 1969. Formisano, V. (Consiglio Nazionale delle Ricerche, Frascati, Italy); Moreno, G.; Amata, E. J. Geophys. Res.; 79: No. 34, 5109-5117(1 Dec 1974).

The statistical properties of the most relevant basic and derived plasma parameters have been studied, using hourly averages supplied by the plasma and magnetic field experiments on board the satellite Heos 1. Average values, medians, and standard deviations are given for all the considered quantities. Comparison with previous results, obtained from the satellites Vela 3/Imp 3 in 1965–1967, confirms the general trend of several relationships among basic and derived parameters. The magnetic energy density is on the average 3 times larger than the proton thermal energy density. When allowance is made for the electron contribution, the internal energy appears to be equipartitioned between plasma and magnetic field. High proton densities seem to be related to magnetic fields with a substantial component normal to the ecliptic plane. (auth)

26866 INTERPLANETARY SECTOR STRUCTURE: 1970–1972. Fairfield, D. H.; Ness, N. F. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 79: No. 34, 5089-5094(1 Dec 1974).

Determination of interplanetary sector structure for the years 1970 to 1972 reveal the persistence of sector patterns during the decreasing portion of the solar cycle. The simple two-sector pattern of 1969 persists through 1970 but develops greater complexity in 1971 to 1972. (auth)

26867 NOTE ON THE BEAMING OF JUPITER'S DECAMETER–WAVE RADIATION AND ITS EFFECT ON RADIO ROTATION PERIOD DETERMINATIONS. Alexander, J.K. (Astro–Geophysics Dept., University of Colorado, Boulder). Astrophys. J. 195: No. 1, 227-233 (1 Jan 1975).

Comparisons of dynamic spectra of Jupiter's decameter wave radiation for events recorded up to ~12 years apart display a high degree of repeatability in that certain spectral features occur at the same central meridian longitude to within $\pm 10°$. The variation in the longitude of the spectral landmarks, which is attributable to a $\pm 10°$ beaming envelope into which the radiation escapes, places a constraint on the precision to which radio rotation–period determinations can be made from measurement of the apparent longitude drift of dynamic spectra. (auth)

26868 MARTIAN MAGNETIC FIELD ACCORDING TO THE MARS-5 SATELLITE DATA. Dolginov, Sh. Sh.; Eroshenko, E. G.; Zhuzgov, L. N.; Sharova, V. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Dokl. Akad. Nauk SSSR; 218: No. 4, 795-798(1 Oct 1974). (In Russian).

Analysis of the magnetograms obtained by Mars-5 indicated that the planet Mars has a natural magnetic field. Under the influence of solar winds this field possesses a characteristic form. It is limited on the day side and expands on the night side. The topology of the field in outer space was determined by the effect of the combination of internal and external field sources. Data on the orientation of the dipole are analyzed. (JSR)

26869 RADIOIZLUCHENIE ZEMLI KAK PLANETY. (Radio-frequency Radiation from the Earth as a Planet). Vasharinov, A. E.; Gurvich, A. S.; Egorov, S. T. Moscow; Izdatel'stvo Nauka (1974). 188p.

The physical bases of the superhigh frequency sounding of the Earth and its atmosphere are discussed. The singularities of the formation of the superhigh frequency radiation in the system of the Earth's surface–atmosphere are examined. Special attention is given to problems having practical results: determination of humidity of the air, water content of clouds, solidarity of ice floes, humidity, and temperature of the Earth's mantle. Sputnik measurements in the superhigh frequency region are generalized. These measurements were made for the first time on Kosmos-243 and Kosmos-384 in 1968 and 1970. Since then other measurements from both Russian and American space vehicles have been accumulated. Future problems for satellite and ground-level superhigh frequency soundings in association with other methods are examined on the basis of the accumulated test results. (tr-auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 25928 and 27895.

26870 (AD-785011) SOLAR-GEOPHYSICAL EFFECTS ON NORTHERN AND MID-LATITUDE ELF PROPAGATION. Davis, J. R.; Meyers, W. D. (Naval Research Lab., Washington, D. C. (USA)). 12 Jul 1974. 26p. (NRL-7771). NTIS $3.25.

The ionospheric phenomena that have the greatest effect on elf propagation occur at middle to northern latitudes under conditions of path darkness. Polar cap events cause increased ion densities in the polar lower d region; these events can lead to greatly increased absorption of northern latitude paths. Under nighttime conditions, precipitated electrons can affect transmitting and receiving stations in the auroral zone by enhancing the conductivity of the lower e region. Precipitation of charged particles trapped in the outer radiation belt can affect stations and paths at even lower latitudes. Examples of elf propagation data under disturbed conditions are rare, but the few that have been recorded in recent years show significant correlation with solar proton flux emissions, galactic cosmic-ray fluctuations, auroral and polar cap absorption events, and geomagnetic storms. These correlations permit a preliminary, qualitative confirmation of the effects that solar charged particle emissions were expected to have on elf propagation. (auth)

26871 (AD-785683) IONOSPHERIC EFFECTS DURING THE PARTIAL SOLAR ECLIPSE OF 10 JUL 1972. Soicher, H.; Gorman, F. J. Jr. (Army Electronics Command, Fort Monmuth, N. J. (USA)). 1971. 8p. NTIS $3.25.

A solar eclipse offers a unique opportunity to study the effects of the rapid disappearance and reappearance of solar thermal and ionization radiations on the ionospheric production, loss, and transport processes which affect the total ionospheric number density. Polarization measurements utilizing beacon emissions of the ats-3 satellite were supplemented with bottomside ionospheric observations made near the subionospheric point during the partial eclipse of 10 Jul 1972. Time variation of the total electron content from 11:00 to 17:30 EST during the eclipse day and during the two days prior to and the three days following it are shown. A comparison of polarization changes during the eclipse day obtained at Fort Monmouth and at Sagamore Hill Radio Observatory, Hamilton, Mass. is given. (GRA)

26872 (AD-786491) OBSERVATIONS AND STUDIES OF AURORAL IONIZATION PROCESSES. Final Report, 12 February 1968–11 May 1970. Skovli, G. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Sep 1970. Contract F61052-68-C-0046. 30p. (NDRE-E-173; AFCRL-TR-74-0427). NTIS $3.75.

The electron flux measurements made by five rocket flights to altitudes covering the lower part of the ionosphere are summarized. The counters used are halogen-quenched Geiger–Mueller tubes with end windows of mica. The energy cut-off values for electrons have been 20 keV, 40 keV and 80 keV, respectively. By simultaneous measurements of electron density profiles the effective loss coefficients have been calculated during three of the flights. The obtained results are in good agreement with previous observations. All observations are made during weakly or moderately disturbed ionospheric conditions. (auth)

26873 (AD-787600) SOVIET STUDIES ON GEOMAGNETIC PULSATIONS, NUMBER 3, OCTOBER 1974. Interim Report, See Also Report Dated December 1973, AD-773176. Hibben, S. G.; Ness, M. (Informatics, Inc., Rockville, Md. (USA)). Oct 1974. 89p. NTIS $4.75.

This is the third collection of abstracts to be published under this contract on soviet work with geomagnetic pulsations. It covers material received in the first half of 1974, as well as a few earlier items not reported in the two previous issues. Emphasis is on pc 1 phenomena, but any article relating to hydromagnetic wave propagation has been included. (GRA)

26874 (AD-787866) QUIPS: (QUIESCENT UNIFORM IONIZED PLASMA STUDIES). Modeling of the Auroral Electrojet. Final Report, 4 May 1973–30 May 1974. Lee, P. H.; Kennel, C. F.; Arnush, D.; Stenzel, R. L.; Wong, A. Y. (TRW Systems Group, Redondo Beach, Calif. (USA)). Aug 1974. Contract F30602-73-C-0293. 39p. (RADC-TR-74-218). NTIS $3.75.

A cylindrical device is constructed for modeling the electrojet instability. The plasma, which is collisional for ions and collisionless for electrons, is produced by two concentric rf exciter discharges in an axial magnetic field. Each exciter consists of two electrically floating concentric strips in a grounded cage. The plasma is confined axially at one end by the cage, at the other end by a segmented anode consisting of 18 concentric rings, and radially by grounded walls at large distances (D 7 OR = LM). The anode rings are connected in series by resistors facilitating the imposition of a radial electric field which causes an azimuthal, closed, Hall current. The plasma density is uniform axially and azimuthally and is controllable radially. (GRA)

26875 (COM-74-50087-359) IONOSPHERIC DATA. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA); National Oceanic and Atmospheric Administration, Boulder, Colo. (USA)). Jul 1974. 120p. (NOAA-FA-359; NOAA-74080603). National Climatic Center, Asheville, NC 28801 $1.00.

The publication contains monthly medians for the month the publication is issued and detailed data for the same month from an exemplary station, Wallops Island (Washington) including daily–hourly values of all characteristics, f-plots for regular world days, and an n(h) contour graph. As timely information, there is included selected ionospheric data for a retrospective world interval, when appropriate. Also given is information on ionospheric data recently received at World Data Center A for solar–terrestrial physics and other information on availability of data from the WDC's. This issue also contains tables and graphs of monthly median ionospheric data for July 1957 and each July to that of 1973. (GRA)

26876 (COO-2482-1) INTERNAL GRAVITY WAVES GENERATED BY A MOVING SOURCE IN A STRATIFIED FLUID. Mager, R. D. (Denver Research Inst., Colo. (USA)). [nd]. Contract AT(11-1)-2482. 93p. (DRI-MS-R-7502). Dep. NTIS $7.75.

The internal gravity wave system produced by a moving source located in a stratified fluid is examined. The stratification of the fluid is exhibited through a vertical variation in the Brunt–Väisälä frequency (which measures the natural frequency of fluid oscillations under the restoring effects of gravity), and through a vertical shear in the transverse ambient flow. The problem is described in terms of a system of partial differential equations for the motion of the fluid. This system is converted into dimensionless form via an appropriate scaling analysis, and linearized by allowing only small perturbations from the ambient state. The solution technique is based on an application of a multi-dimensional Fourier transform in the time and transverse spatial variables. This results in a system of transform equations, which are reduced to a single second-order ordinary differential equation for the transform of the vertical velocity component. This equation is, in turn, solved asymptotically via WKB and Airy function techniques. The inverse transform is then evaluated using the method of multi-dimensional stationary phase, yielding a rigorous asymptotic solution. An alternative formal method of asymptotic solution, based on ray method techniques for hyperbolic partial differential equations, is also performed, and the results are shown to agree with the rigorous solution. (auth)

26877 THEORY OF MEDIUM-SCALE TRAVELING IONOSPHERIC DISTURBANCES. Francis, S. H. (Bell Telephone Labs., Whippany, NJ). J. Geophys. Res.; 79: No. 34, 5245-5260(1 Dec 1974).

Analysis of the excitation of atmospheric gravity waves leads to a hypothesis concerning the nature of medium-scale traveling ionospheric disturbances (TID's) and their relation to large-scale TID's. Stationary phase techniques are used to derive the asymptotic fluctuations of velocity and electron density generated by a line source (e.g., the auroral electrojet). Dissipation by viscosity and thermal conductivity is included in an approximate manner. The gravity wave response includes a discrete spectrum of upper-atmospheric guided modes and a continuous spectrum of freely propagating waves; these two classes of waves can be associated with large-scale and medium-scale TID's, respectively. The medium-scale TID's, in turn, are primarily composed of two families of waves: those that propagate obliquely upward from the source and reach the F region directly and those that propagate initially downward and reach the F region only after reflection from the earth. For an E region source the earth-reflected waves appear as nearly monochromatic wave packets, whereas the direct waves appear for the most part as single pulses; this qualitative difference corresponds to J. E. Titheridge's observational distinction between periodic and nonperiodic TID's. It is suggested that this dichotomy may imply the dominance of upper-atmospheric (as opposed to tropospheric) sources. In this connection the aver-

age fluctuations of the auroral electrojet are shown to be sufficient to generate sizable medium-scale TID's that propagate to large horizontal distances with no loss of amplitude despite the absence of ducting mechanisms. Such propagation is possible because amplitude attenuation due to cylindrical spreading is counteracted by the fact that the lower-frequency waves, which reach the F region at the greater horizontal distances, are generated with larger amplitudes. Several properties of the calculated response, including the linear increase of period and wavelength with distance from the source, might be useful in future observational studies designed to identify the sources of medium-scale TID's. (auth)

26878 EFFECT OF VERTICAL E × B IONOSPHERIC DRIFTS ON F REGION NEUTRAL WINDS IN THE LOW-LATITUDE THERMOSPHERE. Anderson, D. N. (Space Environment Labs., Boulder, CO); Roble, R. G. J. Geophys. Res.; 79: No. 34, 5231-5236(1 Dec 1974).

Daily variations in the vertical E × B drift velocity at F region heights have been observed by the incoherent scatter radar facility at Jicamarca, Peru. Near sunset, large upward drifts are observed to raise the F layer to high altitudes (~500 km); this process significantly depletes the ionization in the lower ionosphere. Owing to the decrease in ion drag the neutral gas accelerates. As the layer descends later in the evening, the ion drag increases, as a result, there is a deceleration of the neutral wind. Vertical velocities resulting from the divergence and convergence of the horizontal neutral winds cause adiabatic cooling and heating, respectively. This dynamic interaction between the neutral and ionized constituents may be responsible for the nighttime neutral temperature perturbation observed near midnight at low latitudes. (auth)

26879 HISSLERS: QUASI-PERIODIC (T ~ 2 s) VLF NOISE FORMS AT AURORAL LATITUDES. Ungstrup, I. M.; Carpenter, D. L. (Stanford Univ., CA). J. Geophys. Res.; 79: No. 34, 5196-5201(1 Dec 1974).

The previously reported "hissler" phenomenon has been studied by means of broad band VLF data from antarctic ground stations and from the polar-orbiting Ogo 2 and Ogo 4 satellites. Hisslers are quasi-periodic broad band VLF auroral noises that typically present a falling-tone characteristic on frequency-time spectrograms and often appear in minute-long sequences with spacing between individual bursts of the order of 2 s at a given frequency. The falling tones do not usually overlap in time; instead a new one tends to develop as the previous one ends. The falling-tone noises are a feature of auroral hiss, in that they occur during time intervals when hiss is observed at ground stations and in portions of space where hiss is observed on polar-orbiting satellites. A survey was made of 1500 Ogo 4 magnetic loop antenna records from the vicinity of Alaska and of the Antarctic. Hisslers were observed at various points from 58° invariant latitude to the mid polar cap, occurring on approximately 40% of the passes. Hisslers were observed from Ogo 4 in various local time and latitudinal sectors of the auroral oval, but there was some evidence of a concentration near $\Lambda = 75°$ and in the premidnight sector. At Byrd, Antarctica (L ~ 7), hisslers are frequently observed prior to the expansion phase of a substorm and during a part of the expansion phase when hiss is detectable on the ground. The study suggests that centers of hissler activity are present on nearly all days, that they may be somewhat localized in space, and that they may be active for periods of several hours. (auth)

26880 OBSERVED CORRELATIONS BETWEEN INTERPLANETARY MAGNETIC FIELD VARIATIONS AND THE DYNAMICS OF THE AURORAL OVAL AND THE HIGH-LATITUDE IONOSPHERE. Pike, C. P. (Air Force Cambridge Research Labs., Bedford, MA); Meng, C. I.; Akasofu, S. I.; Whalen, J. A. J. Geophys. Res.; 79: No. 34, 5129-5142(1 Dec 1974).

Flights of the Air Force Cambridge Research Laboratories flying ionospheric laboratory investigated the day sector of the auroral oval under conditions of darkness. Airborne all-sky cameras and a vertical incidence ionospheric sounder were used to follow the time history of the equatorward boundary of the auroral oval and the F layer irregularity zone (Fliz). In the geomagnetic day sector the Fliz and the discrete auroras are most probably produced by precipitation of particles through the cusp. Meridional motions of the equatorward boundary of the auroral oval and the Fliz were observed to correspond to variations in the interplanetary magnetic field (IMF). Time delays of about 10 to 30 min between a southward turning of the IMF, measured by Explorer 35 at 60 R_E, and the beginning of an equatorward shift of the oval and the Fliz are typical. By combining auroral all-sky camera data from the aircraft with auroral all-sky camera data from the Alaskan meridian chain of stations, which is located in a time sector different from that of the aircraft, we can show that equatorward shifts of the auroral oval can occur over a broad longitudinal (local time) extent. Therefore the size of the auroral oval has a direct dependence on the IMF. Discrete auroras were always seen following a southward turning of the IMF, whereas in some instances, discrete auroras weakened in intensity or disappeared following a northward turning of the IMF. (auth)

26881 PRELIMINARY STUDY OF HIGH-LATITUDE THERMOSPHERIC TEMPERATURES FROM INCOHERENT SCATTER RADAR OBSERVATIONS. Watkins, B. J. (Univ. of Alaska, Fairbanks); Banks, P. M. J. Geophys. Res.; 79: No. 34, 5307-5310(1 Dec 1974).

Incoherent scatter radar ion temperature data from Chatanika, Alaska (L = 5.6), have been used to obtain natural gas temperatures at an altitude of approximately 300 km. An energy balance equation has been developed that takes into account electron gas heating and the high-latitude convective motions of ion and neutral gases, which are coupled through the effect of O^+/O charge exchange. An iterative numerical computer technique is used to obtain a solution for the neutral temperature from the ion energy balance equation in conjunction with model atmospheres of differing exospheric temperatures. Summer-time data are used to illustrate the method. The results show ion-neutral temperature differences during times of small ion-neutral relative velocities to be about 25° to 50°K. The computations are at times strongly affected by the neutral thermospheric wind, which is not measured. (auth)

26882 ESCAPE OF FAST OXYGEN FROM THE ATMOSPHERE DURING GEOMAGNETIC STORMS. Torr, M. R.; Walker, J. C. G.; Torr, D. G. (Yale Univ., New Haven). J. Geophys. Res.; 79: No. 34, 5267-5271(1 Dec 1974).

Observations have been reported of energetic O^+ fluxes (0.7 to 12 keV with energy fluxes of up to 0.4 erg cm^{-2} s^{-1} sr^{-1}) during several magnetic storms. The atmospheric effects to be expected from the precipitation of these fluxes are examined. The fast O^+ ions produce fast O atoms through charge exchange and momentum transfer (yielding atomic oxygen emissions that may be as bright as 200 R). The fast oxygen atoms lose their energy largely through momentum transfer collisions with ambient oxygen atoms. This process produces a large shower of low-energy nonthermal oxygen atoms and results in heating of the atmosphere above 200 km. A substantial number of these oxygen atoms have sufficient energy to escape from the atmosphere. If this type of precipitation event occurs frequently enough, the escape mechanism could result in a significant loss of atmospheric oxygen over the lifetime of the earth. (auth)

26883 NATURE OF MOVEMENTS OF E-REGION IRREGULARITIES AT WALTAIR. Somayaji, T. S. N.; Rao, B. R. (Andhra Univ., Waltair, India). Indian J. Radio Space Phys.; 3: No. 2, 133-136(Jun 1974).

A preliminary investigation is made about the information obtained on the movements of E-region ionospheric irregularities by the fading experiment. The nature of movements observed and the ionospheric region responsible for the observed fading are investigated by analyzing a few day-time E-region drift records and a few night-time blanketing type Es drift records by the cross-spectral analysis. The former corresponds to a case where there is uncertainty, if at all it exists, in the height of reflection, and this uncertainty does not exist in the latter case. The results show that in most of the cases the fading due to a bodily motion of a few (often two or three) classes of irregularities and that the fading is superimposed at or very near the height of reflection. (auth)

26884 INFLUENCE OF GEOMAGNETIC ACTIVITY ON BLANKETING SPORADIC-E. Rao, S. P. M.; Rao, B. R. (Andhra Univ., Waltair, India). Indian J. Radio Space Phys.; 3: No. 2, 186-188(Jun 1974).

The influence of geomagnetic activity on the blanketing sporadic-E has been investigated at low and middle latitudes. The results indicate a positive effect during daytime, and at night, a negative one at low latitudes. The magnetic influence is greater at the equator and less at high latitudes, attaining a maximum value around the geomagnetic latitude of 28°. (auth)

26885 SOME FEATURES OF MID-LATITUDE TROUGH FROM ALOUETTE-II DATA. Lakshmi, D. R.; Reddy, B. M. (National Physical Lab., New Delhi). Indian J. Radio Space Phys.; 3: No. 2, 162-166(Jun 1974).

The Alouette-II satellite (apogee, 3000 km) data have been used with advantage to study the altitude structure of the mid-latitude trough in the topside ionosphere. The electron temperature measurements from Explorer-22 satellite in the same period are also used to indicate the nature of the mean ion mass variation in the trough region. The trough in the O^+-dominant region is explained to be due to the efflux of O^+ ions upwards to

replenish the H^+ ions by charge exchange. The negative gradient in the scale height profiles in the trough region clearly indicates lack of static diffusive equilibrium. The correlation between the "trough" and "knee" locations is poor for quiet conditions, but improves with increasing magnetic activity. (auth)

26886 DETERMINATION OF ELECTRON TEMPERATURE FROM RIOMETER MEASUREMENTS. Kumari, S.; Mahajan, K. K. (National Physical Lab., New Delhi). Indian J. Radio Space Phys.; 3: No. 2, 172-180(Jun 1974).

The various procedures adopted for the indirect determination of electron temperature (T_e) are reviewed with special reference to those making use of riometer measurements. It is shown that riometer can be very usefully employed to estimate the electron temperature around the F_2-peak for ionospheric conditions when $f0F2$ is more than 6 MHz. When $f0F2$ is very low, it is rather difficult to measure T_e by this technique. While discussing the practical utility of the riometer technique to determine T_e by a new easily applicable method, a more practical procedure is outlined to separate out the D- and E-region component from the total absorption. (auth)

26887 ROCKET STUDY OF THE HIGH LATITUDE SUMMER MESOSPHERE. Johannessen, A.; Thrane, E. V. (Norwegian Defense Research Establishment, Kjeller). Indian J. Radio Space Phys.; 3: No. 2, 128-132(Jun 1974).

Experiments conducted in the high latitude summer mesosphere using a Nike–Cajun rocket launched from Andöya (69° 17'N) have been described. The rocket payload was instrumented to study the ion composition near the cold summer mesopause and its relation to ambient temperature, ionization production and ionization loss rate. The results show that hydrated protons $H^+(H_2O)_n$ with $n = 1$ to 6 dominated the ion composition up to 84 km. A rapid transition to NO^+ and O_2^+ dominance took place in the region 84 to 86 km. Simultaneous measurements of electron density (N_e) and ion-pair production (q) revealed that the transition in ion composition was concurrent with a decrease in $\alpha_{eff} = q/N_e^2$ by about a factor 10. (auth)

26888 STUDY OF SOLAR FLARE SIGNATURES ON lf FIELD STRENGTH OVER TASHKENT–DELHI PATH. Subrahmanyam, C. V.; Sastri, J. H.; Deshpande, S. D. (National Physical Lab., New Delhi). Indian J. Radio Space Phys.; 3: No. 2, 153-157(Jun 1974).

Field strength data of lf transmissions from Radio Tashkent (164 kHz) as received at Delhi over a period of six years (1963-68) have been examined for signatures of solar flare events (Sudden field anomaly: SFA). A study of the observed SFA patterns indicates that the solar flare signatures can be classified into six distinct types, viz. I, Ia, Ib, II, III and IV. It is noticed that the trend of the monthly frequency of occurrence of type Ia–SFA signature bears resemblance to that of monthly total ozone content observed at the mid-point of the path. From simultaneous multi-frequency SCNA observations available for a couple of SFA events, it is inferred that type IA-SFA signature is due to a considerable lowering of the reflecting region while type I is due to a change in the electron density gradient at the bottom of the D-region. (auth)

26889 SATELLITE MEASUREMENTS OF PHOTOELECTRON FLUXES. Wrenn, G. L. (University Coll., London (UK). Mullard Space Science Lab.). Ann. Geophys.; 30: No. 1, 49-57(Jan 1974).

From 2nd general scientific assembly of the International Association of Geomagnetism and Aeronomy; Kyoto, Japan (9 Sep 1973).

The importance of photoelectrons produced in the ionosphere has been appreciated for over a decade, and there is now a good theoretical understanding of the physical processes involved. Unfortunately, model calculations are hindered by a lack of suitable input data; this would not matter if reliable direct measurements of photoelectron fluxes were available. In fact, very few experiments have been flown on satellites or rockets with such an objective, and these have suffered from instrumental limitations. A brief discussion of the techniques, retarding potential analysers and electrostatic analysers, is given in order to establish confidence levels in the reported measurements. The photoelectron measurements are then presented in terms of energy spectra, pitch angle distributions and total flux intensities in an attempt to compile a picture of the photoelectrons which escape from the production regions. The production and escape processes clearly depend upon local time, latitude solar activity, etc., but the fact that the photoelectrons become pseudo-trapped is shown to influence the fluxes strongly and lead to significant implications for the heating of the protonosphere and the conjugate atmosphere. (FR)

26890 POLARISATION IN THE NIGHT SKY AT 5,300 Å. Bandermann, L. W.; Wolstencroft, R. D. (Univ. of Hawaii, Honolulu). Nature (London); 252: No. 5480, 215-216(15 Nov 1974).

Observations are reported on the linearly polarized intensity and the orientation angle of the plane of polarisation of night sky radiation at 5300 Å. The measurements have been made since May 1973 with a photoelectric polarimeter at the University of Hawaii. Polarisation maps were prepared from the data and are reproduced, and some of their features are discussed. (UK)

26891 METHOD FOR DETERMINING THE ATMOSPHERIC GAMMA-RAY BACKGROUND. Kurochkin, A. V.; Luchkov, B. I.; Yurkin, Yu. T. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 3, 446-447(1974).

Translated from Kosm. Issled.; 12: No. 3, 486-487(1974).

When astronomical γ-ray observations are made through an appreciable thickness of atmosphere, the principal background radiation that impedes the recording of low flux densities from cosmic sources takes the form of secondary atmospheric γ rays. A method is proposed for determining the background that makes full statistical use of the observations. (WDM)

26892 FADEOUT DURATION AND AMPLITUDE FLUCTUATION OF RADIO SIGNALS FROM ARTIFICIAL SATELLITES AT THE NORTHERN POLAR CAP AND AURORAL ZONE. Ivanov, Yu. G.; Kuperov, L. P.; Solodovnikov, G. K.; Chalaya, M. N. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 3, 357-363(1974).

Translated from Kosm. Issled.; 12: No. 3, 387-395(1974).

An analysis was conducted of the duration of signal fadeouts from artificial satellites in high-latitude orbits as a function of altitude, azimuth, and zenith angle of the satellite. Results of studies of amplitude fluctuation of signals at various geomagnetic latitudes are presented. Recordings of signal amplitudes from the satellites Kosmos 321, Kosmos 356, and Kosmos 381 at a frequency of 20 MHz made by the drifting polar stations North Pole-16 and North Pole-19 were utilized. (auth)

26893 DINAMIKA IONOSFERNOI PLAZMY. (Dynamics of Ionosopheric Plasma). Gershman, B. N. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Matematicheskoi Literatury (1974). 256p.

The theory of dynamic processes in weakly ionized ionospheric plasma is considered. Special attention is given to the E and F regions which play a large role in the propagation of radiowaves. The effect of the movement of neutral particles on the transfer or redistribution of ionized components is examined for different altitudes. Questions on the magnetohydrodynamics of ionospheric gases are clarified. Mechanisms for the origin of inhomogeneities of the electron concentration and sporadic layers are analyzed. Problems of the excitation of currents and electrostatic fields under ionospheric conditions are considered. Much attention is given to the theory of the diffusion of ionospheric inhomogeneities. (tr-auth)

26894 SOLAR FLARE EFFECTS ON A_1-ABSORPTION. Ganguly, S. (Bose Inst., Calcutta). Indian J. Phys.; 48: No. 7, 593-606(Jul 1974).

Continuous monitoring of A_1-absorption data was used in obtaining some pertinent features of flare signatures. The usefulness of this technique in predicting, patrolling, and in obtaining useful parameters of both solar radiations and ionospheric processes, particularly for those with lower magnitudes is stressed. The data were utilized in deducing the loss rate in the D region for heights of around 80 km, where the A_1-observations are most sensitive and other observations are rather meagre. The different methods employed in deducing the loss rates include (i) the relaxation time during a flare, (ii) the decay of ionization after a flare, (iii) the decay of ionization after sunset, and (iv) the comparison of the production rate with absorption during a flare. In spite of the various uncertainties, mainly arising through the height integrated absorption measurements, the different methods yield a rather consistent value of α_0 of the order of 10^{-7} cm^3sec^{-1}, and λ of around 1. (auth)

Magnetospheric Phenomena

Refer also to abstract 26798.

26895 (JPRS-62550) SCIENTIFIC STUDIES IN SPACE: SOME RESULTS, PROBLEMS, AND PROSPECTS. Sagdeev, R. Z.; Zaitsev, Yu. I. Translated from Priroda; No. 5, 4-13 (May 1974). 23p. NTIS $3.00.

The report contains a review of some results, problems, and prospects of scientific studies in space. (GRA)

26896 MAGNETIC FIELD CONFIGURATION IN THE MAGNETOTAIL NEAR 60 R_E. Meng, C. I.; Anderson, K. A. (Univ. of California, Berkeley). J. Geophys. Res.; 79: No. 34, 5143-5153(1 Dec 1974).

The magnetic field line configuration in the geomagnetic tail near 60 R_E is examined on the basis of nearly 3 years of magnetometer data from the lunar-orbiting Explorer 35 satellite. The magnetotail field line characteristics inside the plasma sheet and in the high-latitude tail, i.e., outside the plasma sheet, are separately examined. In the high-latitude tail the magnetic field lines systematically diverge in both longitudinal (east-west) and latitudinal (north-south) directions; the divergence angle between field lines near the dusk flank and those near the dawn flank is about 14°, but the divergence along the Z direction is only about 8°. The degree of divergence is found to be greater in the evening side than in the morning side and greater in the northern tail than in the southern tail. Inside the plasma sheet the field lines deviate by about 19° from the sun-earth line, and the spatial distribution of the field line deviation does not have any systematic tendency. The average longitudinal and latitudinal deviation is about 20° and 17°, corresponding to the average $|B_y|$ and $|B_z|$ of 1.9 γ and 1.7 γ, respectively. The geomagnetic activity dependence of the field line configuration is also examined, and no drastic different is found during different K_p periods. (auth)

26897 APPLICATION OF LINEAR INVERSE THEORY TO A LINE CURRENT MODEL OF SUBSTORM CURRENT SYSTEMS. Horning, B. L.; McPherron, R. L.; Jackson, D. D. (Univ. of California, Los Angeles). J. Geophys. Res.; 79: No. 34, 5202-5210(1 Dec 1974).

The geomagnetic components from eight low-latitude ground stations and the ATS 1 satellite are studied for substorms occurring on December 24 and 25, 1967, and on August 15, 1968. A simple, four-parameter, field-aligned line current model is employed, and the linear inverse problem is constructed to determine the set of model parameters that best fit the data. A straightforward review of linear inversion theory is included in the theory section. The four model parameters are the magnitude of the current, the L shell on which the current flows, and the azimuthal positions of the eastern and western portions of the circuit. Both growth phases and expansion phases are treated. The best fits to the ground and satellite data are shown to be independent of the L parameter for values of $L \gtrsim 3.5$ when only ground data are treated and for values of $L \gtrsim 8.5$ when satellite data are included. The four-parameter model, although it produces good qualitative fits to expansion phase data, is unable to fit the data within 2 standard deviations of the error in the observations. The model is able to fit the growth phase of one substorm within 1 standard deviation. In one substorm with an apparent growth phase a better fit of the data during the expansion phase was obtained by combining the line current model of the growth phase with an additional four-parameter line current model. (auth)

26898 INFLUENCE OF THE DIRECTION OF THE GEOMAGNETIC DIPOLE ON THE POSITION OF THE NEUTRAL SHEET. Bowling, S. B. (Rice Univ., Houston, TX). J. Geophy. Res.; 79: No. 34, 5155-5158(1 Dec 1974).

An analysis of neutral sheet crossings detected by the NASA–Goddard Space Flight Center magnetometer on the Explorer 34 satellite has shown that the diurnal wobble of the geomagnetic dipole measurably influences the position of the neutral sheet at 30 R_E. Viewed in the solar-ecliptic coordinate system, the dipole wobble originates from the 11° angle between the earth's spin axis and the dipole axis, has a period of 24 hours, and can be resolved into components of motion perpendicular and parallel to the earth-sun line. The perpendicular component exerts a torque on the magnetotail and causes the neutral sheet to pivot about an axis approximately parallel to the solar wind direction. The parallel component encourages the neutral sheet to move above and below the solar-magnetospheric equatorial plane with an amplitude of 1 R_E. This latter motion is consistent with the neutral sheet's being hinged at a geocentric distance of 5.25 R_E. Although hinging is not as dominant a feature of neutral sheet motion pivoting at 30 R_E, both are in phase with the 24-hour precession of the dipole axis about the earth's spin axis. (auth)

26899 HYDROMAGNETIC WAVES EXCITED DURING AN SSC. Kaufmann, R. L.; Walker, D. N. (Univ. of New Hampshire, Durham). J. Geophys. Res.; 79: No. 34, 5187-5195 (1 Dec 1974).

The effects of hydromagnetic perturbations that were excited by an ssc were seen at L = 8.2, −12° geomagnetic latitude, 0610 geomagnetic local time in Explorer 12 energetic particle and magnetic field data, and on ground magnetograms. The entire day side magnetosphere was compressed by 2–3 R_E in 2–3 min. This compression and the accompanying increase in magnetopause currents produced in 25-γ enhancement of the magnetic field at the satellite and a worldwide 45-γ enhancement at the ground. Energetic electron fluxes rose sharply at the satellite, indicating that particles moved earthward and were accelerated as the magnetic field was compressed. An additional 15-γ 2-min enhancement of the magnetic field was seen at the satellite. This pulse did not significantly enhance energetic electron fluxes and did not produce worldwide ground effects, though associated perturbations are present in some ground records. The pulse appears to represent a localized compressional magnetoacoustic wave that was excited by the rapid magnetopause motion. Finally, a damped toroidal oscillation with an initial amplitude of 26 γ, a period of 250 s, and an exponential damping time of 400 s was seen at the satellite. This oscillation could not be seen at any available ground station, the indication being that it was confined in latitude or longitude. The damping could be produced either by the coupling of energy between wave modes or by finite ionospheric conductivity. The wave period agrees with predictions if the density of plasma on the field line varies with radial distance as r^{-6}, with ρ = 4 to 12 ions/cm^3 at the equator. An initial energy input of 4×10^{20} dL to 2×10^{21} dL ergs can produce the observed wave amplitude, if plasma at all longitudes between the L and the L + dL shells is involved in the oscillation. (auth)

26900 MAGNETOHYDRODYNAMIC ASPECTS OF THE EARTH'S BOW SHOCK. I. Equilibrium Bow Shock Position. Auer, R. D. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). J. Geophys. Res.; 79: No. 34, 5118-5120 (1 Dec 1974).

The fluid dynamic treatment of the magnetosphere-bow shock system provides a useful means to calculate the equilibrium standoff distance of the shock. From the simple gas dynamic model a specific heat ratio $\gamma \approx 5/3$ of the streaming plasma is found to be appropriate for average solar wind conditions. This result has been derived from different satellite observations. (auth)

26901 MAGNETOHYDRODYNAMIC ASPECTS OF THE EARTH'S BOW SHOCK. II. Motions Induced by Directional Discontinuities. Auer, R. D. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). J. Geophys. Res.; 79: No. 34, 5121-5128(1 Dec 1974).

From measurements made by the Heos 2 satellite a spread of bow shock locations is observed, oblique shocks (in the hydromagnetic sense) lying more earthward than perpendicular ones. This result is interpreted as a dynamic effect rather than as being due to different field-determined static equilibrium configurations. A simple hydromagnetic model for the impulsive interaction of the bow shock with a discontinuity in magnetic field direction is stated and discussed quantitatively. It is found that velocities of the order of 10 km/s can be induced thereby. The observed spread in bow shock positions as well as the correlation with magnetic field orientation can be explained by our model. (auth)

26902 MODEL OF THE MAGNETOPAUSE USING AN ANGULAR DISTRIBUTION FUNCTION FOR THE INCIDENT PARTICLES. Cap, F. F.; Leubner, M. P. (Institut fuer Weltraumforschung, Innsbruck). J. Geophys. Res.; 79: No. 34, 5304-5306(1 Dec 1974).

A modified theoretical model of the magnetopause in the noon-midnight meridian plane is proposed. A pressure balance equation is given that takes into consideration both the theory of Beard for parallel incident solar wind particles and the turbulent plasma in the magnetosheath by using an angular distribution function. A variation of the intensities of the two different particle streams shows the effect of nonparallel incident particles on the shape of the magnetopause in the meridian plane. The geomagnetic latitude of the neutral points decreases with increasing density of particles having an angular distribution. (auth)

26903 ROCKET OBSERVATION OF SOFT ENERGETIC PARTICLES AT THE MAGNETIC EQUATOR. Goldberg, R. A. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 79: No. 34, 5299-5303(1 Dec 1974).

Results from a rocket-borne ion mass spectrometer flown near the magnetic equator at 0108 LMT (local mean time) on March 10, 1970, exhibit an unusual background current above 200 km. This current is observed to increase by 3.5 orders of magnitude between 200 and 260 km before maximizing to a fixed value from 260 km to the 295-km apogee of the flight. Properties of the background combined with laboratory measurements have permitted probable identification of the background source as 2- to 20-keV electrons or protons. Maximum electron fluxes have been estimated to be of the order of 10^{10} particles/cm^2 s sr in accord with Isis 1 satellite measurements at higher altitudes. The background was not observed on an earlier flight at 1938 LMT, suggesting the particles to be quasi-trapped in a belt that drifted below 300 km between the two flights. The low altitude penetration of these fluxes may

have been related to the great magnetic storm of March 8. Simultaneous measurements of the thermal ion distribution are compared with these results and qualitatively suggest that the soft energetic particles are responsible for an observed O_2^+ and NO^+ enhancement. (auth)

26904 NEUTRAL POINT DETECTION BY SATELLITES. Schindler, K. (Ruhr-Univ., Bochum, Ger.); Ness, N. F. J. Geophys. Res.; 79: No. 34, 5297-5298(1 Dec 1974).

The concept of a neutral point depends on the physical phenomena described. The regions with $B \lesssim 1\ \gamma$ detected by Schindler and Ness may be interpreted as neutral regions for the ion-tearing process. The assumption of the presence of a multiple neutral point structure (with temporal variations) is still the most promising interpretation of the Explorer 34 data. Alternatives suggested by Russell lead to difficulties. Nevertheless, the final answer can come only from multiple satellite systems. A 1-day displacement of the day count in the data discussed by Schindler and Ness is corrected. (auth)

26905 PULSE PROPAGATION IN A MAGNETOPLASMA. II. Transverse Propagation. Bloch, S. C. (Univ. of S. Florida, Tampa); Boss, A. P.; Lyons, P. W. J. Geophys. Res.; 79: No. 34, 5261-5266(1 Dec 1974).

Results of computer experiments are described for electromagnetic wave pulse trains propagating perpendicular to a static magnetic field in a collisional magnetoplasma governed by the Appleton–Hartree dispersion relation. For a rectangular incident pulse envelope the transmitted envelopes are obtained as functions of time for selected combinations of ω_p/ω_0, ω_c/ω_0, ν/ω_0, propagation distance, and pulse width. Some results are compared with the case of longitudinal propagation for similar plasma parameters. Cross correlations of transmitted pulses with the incident pulses are also obtained. (auth)

26906 MAGNETOSPHERIC SURFACE FLOW WITH STRONG DISCONTINUITIES. Ivanov, K. G. (AN SSSR, Moscow. Inst. Zemnogo Magnetizma, Ionosfery i Rasprostraneniya Radiovoln). Astrophys. Space Sci.; 31: No. 2, 287-294(Dec 1974).

The theory of strong discontinuities in plasma with anisotropic pressure is applied for interpretation of the recent plasma and magnetic experiments on the boundary and in the tail of the magnetosphere. The properties of the discontinuities are described. It is supposed that on the boundary and in the tail of the magnetosphere anistropic discontinuities occur with a nonzero normal component of the magnetic field. The general consequence of this assumption is the existence of the magnetospheric surface flow expanding from the subsolar point. The consequence does not contradict the data obtained on IMP 5. For the investigation of the low-latitude part of the flow, the use of electrostatic analysers is desirable with the entrance oriented along the magnetospheric surface. The well-known qualitative scheme of the hydrodynamical flow with strong discontinuities in the tail is generalized by means of the three anisotropic discontinuities; the contact one coinciding with the magnetic neutral sheet, and the two discontinuities with the nonzero normal flow of the mass simulating the boundary of the plasma sheet. The result of the scheme of the components of the bulk velocity in the plasma sheet agrees with the recent observations on the Vela 4B. The scheme connects the well-known phenomena of the blocking and the thinning of the plasma sheet in the initial phase of the substorm. According to the general principles of the reconnection the dynamical dissipation is decreased by the blocking of the flow in the plasma sheet. The decrease leads to a drift of the plasma sheet boundary in the neutral sheet direction. The reverse picture is probably a result of a relaxation of the blocking. (auth)

26907 INTERACTION BETWEEN THE ELECTRON–CYCLOTRON EMISSIONS AT $(n+1/2)\ \Omega_e$ AND THE RING–CURRENT PROTONS IN SPACE. Nambu, M. (General Education Department, Kyushu University, Ropponmatsu, Fukuoka, 810, Japan). Phys. Rev. Lett. 34: No. 7, 387-391 (17 Feb 1975).

The interaction between the electron–cyclotron emissions at $(n+1/2)\ \Omega_e$ and the ring–current protons is studied by using the linear–response theory of a turbulent plasma. The effective turbulent collisions come from the decay interactions between the electron–cyclotron turbulence and electrostatic ion–cyclotron waves. The ion–cyclotron waves generated by the generalized parametric resonance are effective for the loss of the ring–current protons. The critical electron–cyclotron–turbulence amplitude is consistent with the observed value. (auth)

26908 ENERGY SPECTRA AND CHARGE STATES OF H, He, AND HEAVY IONS OBSERVED IN THE EARTH'S MAGNETOSHEATH AND MAGNETOTAIL. Fan, C.Y. (Department of Physics, University of Arizona, Tucson, Arizona 85721); Gloeckler, G.; Hovestadt, D. Phys. Rev. Lett. 34: No. 8, 495-498 (24 Feb 1975).

H, He, and heavy ions of energies ≥ 0.12 MeV/charge were detected in the magnetotail and in the magnetosheath. It was found that their relative abundances were $\sim 9{:}1{:}4\times10^{-2}$, their differential energy spectra were $\sim 1/E^4$, and their atomic electrons were almost completely stripped. These results led us to suggest that they were the low–energy "quiet–time" cosmic rays accelerated within the magnetotail and the magnetosheath to the observed energies. (auth)

26909 CHARACTERISTIC PARAMETERS OF THE IONOSPHERIC–MAGNETOSPHERIC MEDIUM. Kovalevskii, I. V. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 3, 370-384(1974).

Translated from Kosm. Issled.; 12: No. 3, 402-418(1974).

An empirical model for the macroscopic parameters (n_α, T_α, m_α, and the magnetic-field strength B, where α = n,e,i designates the neutral particles, electrons, and ions in the plasma) of the circumterrestrial medium is compiled in tabular form for the height range h = 50 to 31,850 km in the equatorial region during a period of minimum solar activity, for both a winter day and a winter night. The following characteristic parameters of the ionospheric–magnetospheric plasma are evaluated and discussed: the ratio β of the plasma pressure to the magnetic pressure; the frequencies ω_{pe}, ω_{pi}, ω_{H_e}, ω_{H_i}, ν_{en}, ν_{in}, ν_e, ν_{ei}; the lengths r_D, r_{H_e}, r_{H_i}, l_e, l_i; the velocities v_{t_e}, v_{t_i}, v_A; and four specific electrical conductivities σ_1–σ_4. The results are tabulated and displayed in graphs. (auth)

26910 QUESTION OF THE DYNAMICAL COORDINATE SYSTEM IN A GEOMAGNETIC TRAP. Bogdanov, V. V.; Pletnev, V. D. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 3, 350-356 (1974).

Translated from Kosm. Issled.; 12: No. 3, 380-386(1974).

A dynamical coordinate system which can be used to describe the distribution of particles trapped by the geomagnetic field is proposed as a concrete model of geomagnetic field perturbations taking account of the conservation of the three adiabatic invariants. It is possible to use this coordinate system where the conditions for applying the natural McIlwain coordinates are not met. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 26958, 27003, and 28908.

26911 (AD-783921) ATOMIC AND MOLECULAR PHYSICS WITH EMPHASIS ON ATOMIC AND MOLECULAR BEAMS. Final Technical Report, 1 May 1966–30 April 1970. Kusch, P.; Novick, R. (Columbia Univ., New York (USA). Columbia Radiation Lab.). Aug 1974. Contract N00014-67-A-0108-0002. 12p. (CAL-1271). NTIS $3.00.

The principal achievements of a research program in atomic and molecular physics are summarized. Spectroscopic studies of the cesium molecule and lifetime measurements of an electronic state of molecular hydrogen are summarized. In atomic physics, studies were made of the hyperfine structure of metastable hydrogen atoms, the two-photon decay of metastable hydrogenic atoms, and optical excitation of helium atoms with low energy ions. A rotating square-wave polarizer was also developed. (auth)

26912 (HU-TFT-74-2) MOTION OF POSITRONS IN METALS. Bergersen, B.; Pajanne, E. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Jan 1974. 40p. INIS.

The different aspects of positron annihilation in metals that involve the dynamics of positron motion before annihilation are discussed. The emphasis is on the theory, but also some experimental evidence is quoted. The topics covered are: slowing down and thermalization, effective mass, temperature dependence of positron vacancy trapping, positron channeling, and escape of low energy positrons from metal surfaces. (auth)

26913 (JINR-1-7549) ACCOUNTING COULOMB MULTISCATTERING IN SIMULATION OF CHARGED PARTICLE TRAJECTORIES. Al'brekht, K. F.; Likhachev, M. F.; Maier, A.; Ryzek, Kh. E.; Savin, I. A.; Takhtamyshev, G. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 14p. (In Russian). INIS.

A description is given of a simple method of modeling the process of multiple scattering on passage of particles through the elements of an experimental unit, which can be used for calculating the resolution of the unit and also for calculating the charged particle beams. (tr-SJR)

26914 (KIYAI-73-3) CREATION OF THE ^{3}He POLARIZED BEAM SOURCE BY USE OF THE METASTABLE $2S_{\frac{1}{2}}$ STATE. Zaika, N. I.; Mokhnach, A. V. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1973. 13p. (In Russian). INIS.

The possibility of creating a polarized beam source and evaluating its parameters are examined. By use of the charge exchange process $He^{2+} + H \rightarrow He^{+} + H^{+}$ to obtain the metastable $^3He^{+}$ $2S_{\frac{1}{2}}$ ions, the resonance intersection of the ion levels in a magnetic field with intensity of 7550 Oe, and the process of secondary charge exchange of the metastable ions in hydrogen, a beam of doubly charged $^3He^{2+}$ ions can be obtained with polarization ~50% and intensity 4 to 5 orders of magnitude higher than the original beam intensity. The method can be used also for measurement of the polarization of $^3He^{2+}$ beams by nonnuclear methods. (tr-auth)

26915 (SRIA-115P84X1) PROCESSES OF ENERGY DEPOSITION BY HEAVY PARTICLE IMPACT. Salop, A.; Smith, F. T. (Stanford Research Inst., Menlo Park, Calif. (USA)). 31 Aug 1974. Contract AT(04-3)-115. 8p. Dep. NTIS $4.00.

A brief summary of research activities on inelastic collision processes is presented. Total Landau-Zener cross sections for charge exchange between atomic hydrogen and fully stripped C, Ar, K, and Xe ions are illustrated. (CES)

26916 (UCID-16716) UNIVERSAL CURVES FOR PREDICTING EQUILIBRIUM RADII OF RELATIVISTIC ELECTRON BEAMS INCLUDING THE EFFECTS OF ATTRACTIVE SELF FORCE, EXTERNAL B_z, INITIAL BEAM QUALITY AND SCATTERING IN THE GAS ENTRY FOIL. Lauer, E. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1975. Contract W-7405-Eng-48. 14p. Dep. NTIS $4.00.

In addition to the equilibirum radii of relativistic electron beams, the beam properties are described and the envelope equation is derived. (JFP)

26917 INTERACTION OF ATOMIC PARTICLES WITH SOLID SURFACES AT INTERMEDIATE ENERGIES. IV. The Energy and Angular Distributions of Particles Scattered with Electric Charge from Polycrystalline Platinum at Bombarding Energies of 500 to 5000 eV. Cawthron, E. R. (Australian National Univ., Canberra). Proc. Roy. Soc. (London), Ser. A; 341: No. 1625, 213-231(12 Nov 1974).

The distributions in angle and energy for charged particles emitted from polycrystalline platinum bombarded with ions of hydrogen, sodium, potassium and some hydrocarbons, have been measured, in continuation of previous work (Cawthron, E. R.; Cotterell, D. L. and Oliphant, M. L. Proc. R. Soc. Lond.; A 314: 3-51 and 53-72 (1969). Proc. R. Soc. Lond.; A319: 435-59(1970)) to lower energies. Composite spectra are presented, including ions of both signs. The flux of emitted charged particles, under hydrogen ion bombardment, is shown to contain approximately equal numbers of protons and H^- ions, except at the lowest bombarding energies, where the latter apparently predominate. Scattering in all cases is shown to increase with bombarding energy over the range covered, the increase being near linear for hydrogen and very rapid for alkali-metal ions. In all cases the total emission of charged particles is very small at the lowest bombarding energies employed. (auth)

26918 NEW UTILIZATION OF ^{11}B ION BEAMS. Hydrogen Analysis by $^1H(^{11}B,\alpha)\alpha\alpha$ NUCLEAR REACTIONS. Ligeon, E.; Guivarc'h, A. (CEN, Grenoble, France). Radiat. Eff.; 22: No. 2, 101-105(Jun 1974).

The study of the α particles emitted by the nuclear reaction $^1H(^{11}B,\alpha)\alpha\alpha$ near the resonance of 1793 keV was used to analyze hydrogen in solids. It is shown that it is possible to detect surface layers less than $\approx 5.10^{13}$ atoms hydrogen/cm^2 and that the profile of implanted hydrogen can be determined to a depth of 4000 Å with a depth resolution about 400 Å. An advantage of this method consists in the use of standard low energy accelerator (~2 MeV). Comparisons with other nuclear methods are made, and several applications are suggested. (auth)

26919 IDENTIFICATION OF Kα X-RAY SATELLITE LINES INDUCED BY MeV HEAVY-ION BOMBARDMENT OF ELEMENTAL TARGETS. Larkins, F. P. (Monash Univ., Clayton, Victoria). Aust. J. Phys.; 27: No. 2, 177-180(Apr 1974).

It is shown that multiply ionized atoms with one or two holes in the 2s subshell in addition to holes in the 2p subshell may contribute direction to the observed Kα satellite and hypersatellite spectra reported for targets bombarded with highly energetic heavy ions. The direct participation of such defect configurations results because the normally rapid $L_1-L_{23}M$ Coster–Kronig transition processes are energetically forbidden for most excited atomic species that are multiply ionized in the L shell. Adiabatic nonrelativistic Hartree–Fock calculations are presented to support this conclusion. A detailed calculation for the Kα satellite and hypersatellite spectra of the silicon system is given. (auth)

26920 K-SHELL EXCITATION AND OUTER SHELL CONFIGURATION IN ION-ATOM COLLISIONS. Macek, J.; Briggs, J. (Univ. of Nebraska, Lincoln). Comments At. Mol. Phys.; 4: No. 4, 97-101(Jul 1973).

Recent studies indicate that excitation of inner shells by the molecular promotion mechanism can be calculated quantitatively for the simplest type of collisions, namely symmetric collisions between first row atoms. The inner shell excitation cross section factors into two parts, one relating to promotion taking place at small internuclear distances where the K-shells interpenetrate, and one relating to larger internuclear distances where the outer shells interpenetrate. Theoretical understanding of the inner region dynamics is much more advanced than the understanding of the outer region. By using theoretical promotion probabilities, which constitute the inner region factor, and experimental cross sections, an empirical factor relating to the outer regions is obtained. Data relating to this factor are reviewed, and gaps in present knowledge are pointed out. (9 references). (auth)

26921 TRAPPING AND RE-EMISSION OF DEUTERIUM FROM MOLYBDENUM FOLLOWING BOMBARDMENT AT 77K. Erents, S. K. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Vacuum; 24: No. 10, 445-449(Oct 1974).

The re-emission of deuterium from molybdenum during 7 keV D^+ bombardment at 77K has been measured and this data compared with 20 keV D^+ bombardment. Thermal desorption spectra show an increase in the number of peaks at lower temperatures as the incident ion dose is increased. The results may be interpreted by an increase in the population of trapping (damage) sites created during previous irradiations, in addition to a broadening of the range distribution to intersect the surface. This leads to a diffusion peak much wider than that normally considered for diffusive release. (auth)

26922 MULTICHANNEL EIKONAL TREATMENT OF ATOMIC COLLISIONS: e−H(1s) ELASTIC AND INELASTIC SCATTERING. Flannery, M. R.; McCann, K. J. (Georgia Inst. of Tech., Atlanta). J. Phys., B (London); 7: No. 18, 2518-1532(21 Dec 1974).

A multichannel eikonal description of atomic collisions is presented. The basic formula for the scattering amplitude reduces upon successive approximation to expressions previously derived. In particular, the equations, in the heavy-particle or high-energy limit reduce to the standard impact parameter formulae. A four-state treatment of e-H(1s) elastic and 2s and 2p inelastic scattering is carried out. The calculated cross sections, which illustrate the effects of various approximations, compare very favourably with other refined theoretical methods and with experiment. (auth)

26923 SCATTERING MECHANISMS IN LOW-ENERGY e−H_2O COLLISIONS. Seng, G.; Linder, F. (Univ., Kaiserslautern, Ger.). J. Phys., B (London); 7: No. 17, L509-L512(1 Dec 1974).

Crossed beam experiments have been performed to study elastic scattering and vibrational excitation in e−H_2O collisions for the energy range from 1 to 10 eV. The rise of the cross sections at low energies (below 2 eV) is interpreted in terms of a direct scattering mechanism, whereas the broad enhancement of the cross sections around 6 to 9 eV is attributed to H_2O^- states intersecting the Franck-Condon region in this energy range. Theoretical estimates for the energies of H_2O^- states are not in agreement with these findings. (auth)

26924 TWO-CENTRE EXCHANGE MATRIX ELEMENTS AND THE MASS DEPENDENCE OF THE CHARGE TRANSFER CROSS SECTION IN ION-ATOM COLLISIONS. Msezane, A.; Gallaher, D. F. (Univ. of Western Ontario, London). J. Phys., B (London); 8: No. 1, 112-120(11 Jan 1975).

Directly useable expressions for the one dimensional integrals arising from the exchange matrix elements of the types occurring in close coupling-based treatments of ion-atom scattering are presented. Using these expressions, the total charge transfer cross sections for both the processes $^3He^{2+}$-H and $^4He^{2+}$-H at impact velocities of 0.5 au and 0.25 au have been computed in a four state (1s, 2s, $2p_0$, $2p_1$) approximation. The results demonstrate that the simple scaling procedure usually employed to achieve comparison between theoretical calculations and experimental measurements for the reaction He^{2+}-H with mass 3 and mass 4 projectiles is, in general, not valid. There is an explicit mass dependence of the cross sections. (auth)

26925 ANGULAR DISTRIBUTIONS OF ELECTRONS EJECTED FROM ATOMS AND MOLECULES BY FAST CHARGED IONS. Band, Y. B. (Univ. of Chicago). J. Phys., B (London); 7: No. 18, 2557-2562(21 Dec 1974).

Doubly differential cross sections for ejection of secondary electrons by fast ions have been calculated using linear combinations of products of atomic orbitals with "inter-nuclear" wavefunctions which asymptotically represent incoming and outgoing states. Numerical results for incident protons on He and H_2 targets are compared with experiments. The behavior of the cross sections in the forward peak of the experimental angular distribution, previously unaccounted for in the Born and binary-encounter calculations, is reproduced quantitatively. (auth)

26926 EXCITATION OF THE 2^1P MAGNETIC SUBLEVELS OF HELIUM BY FAST ELECTRONS. Joachain, C. J.; Vanderpoorten, R. (Univ., Brussels). J. Phys., B (London); 7: No. 18, L528-L530(21 Dec 1974).

The eikonal DWBA approximation is used to obtain the ratio of the differential cross sections for exciting the magnetic sublevels of the helium 2^1P state by fast electrons, together with the relative phase of the corresponding scattering amplitudes. The results are compared with the experimental data of Eminyan et al (J. Phys. B. Atom. Molec. Phys.; 7: 1519-42 (1974)). (auth)

26927 APPLICATIONS OF THE GLAUBER APPROXIMATION TO ATOMIC COLLISIONS. Gerjuoy, E.; Thomas, B. K. (Univ. of Pittsburgh). Rep. Progr. Phys.; 37: No. 11, 1345-1431(1974).

Applications (to July 1973) of the Glauber approximation to elastic and inelastic collisions of charged particles with neutral atoms are critically reviewed in an attempt to assess the utility of the Glauber approximation in the atomic collisions domain. Various alternative derivations of the Glauber amplitude formula, both for potential scattering and for composite collisions, also are described and compared. A number of possible problems for future research are listed. (auth)

26928 Z_1 OSCILLATIONS IN STOPPING POWER OF METALS FOR LOW VELOCITY CHANNELLED HEAVY IONS. Pathak, A. P. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Phys., F (London); 4: No. 11, 1883-1888(Nov 1974).

A model of stopping of a low velocity heavy ion moving through an electron gas has been used to calculate the stopping power of gold and tungsten for ions ($6 \leq Z_1 \leq 54$) channelled along ⟨110⟩ Au and ⟨100⟩ W directions. A comparison of the results with experimental data shows satisfactory agreement and a definite improvement over modified Firsov theory in producing deep minima for some of the projectiles. (auth)

26929 PSEUDOSTATE MULTICHANNEL EIKONAL STUDY OF e−H(1s) INELASTIC COLLISIONS. Flannery, M. R.; McCann, K. J. (Georgia Inst. of Tech., Atlanta). J. Phys., B (London); 7: No. 18, L522-L527(21 Dec 1974).

The effect of including the 3s and 3p pseudostates is examined for the 2s and 2p excitation of atomic hydrogen by incident electrons with energy E (eV) in the range $16.5 \leq E \leq 200$. The 2s excitation is most strongly affected and displays a behavior consistent with measurement and refined theories which include polarization. The 2p excitation agrees particularly well with the full quantal pseudostate treatment and with experiment. A seven-channel (1s, 2s, 2p, 3s, 3p) treatment is also performed, and the resulting 2s and 2p cross sections lie closer to those of the pseudostate description than to the four-channel (1s, 2s, 2p) results, as expected. (auth)

26930 DIFFERENTIAL ELASTIC SCATTERING OF ELECTRONS BY THE RARE GASES. I. Helium. McConkey, J. W.; Preston, J. A. (Windson Univ., Ont.). J. Phys., B (London); 8: No. 1, 63-74(11 Jan 1975).

Differential cross sections for the elastic scattering of electrons by helium have been measured in the angular range 20° to 90° and the energy range 1.5 to 100 eV. Absolute calibrations from phase shift determinations at 19.1 eV and via normalization to the data of Vriens et al (Phys. Rev.; 170: 163-9 (1968)) and Chamberlain et al (Phys. Rev.; A2: 1905-22 (1970)) at 100 eV are in agreement to 2%. The estimated accuracy of the cross sections is ±12%. A detailed description of the experimental procedure is given and the results are compared with other recent experimental results and theoretical calculations. (auth)

26931 MEASUREMENT OF THE TOTAL COEFFICIENT OF BACK SCATTERING OF β PARTICLES FROM THICK SUBSTRATES (SATURATION CASE). Geidel'man, A. M.; Soloshenkov, P. S.; Fedotov, P. I.; Khol'nov, Yu. V. pp 26-29 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (Ed.). Moscow; Atomizdat (1974). (In Russian).

The total coefficient of the backscattering of electrons of ^{60}Co, ^{137}Cs, ^{170}Tm, and ^{89}Sr was measured for thick substrates of Be, plexiglass, Al, Ti, stainless steel, brass, W, and Pb. The values obtained are tabulated. With increase of the energy of the β particles a small (within limits of 15%) increase of the back scattering coefficient was observed for all the substrates studied. No dependence on the quality of the surface was observed. (JSR)

26932 INTENSE FOCUSING OF RELATIVISTIC ELECTRONS BY COLLAPSING HOLLOW BEAMS. Blaugrund, A.E.; Cooperstein, G. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Rev. Lett. 34: No. 8, 461-464 (24 Feb 1975).

Low−impedance diodes with hollow tapered cathodes produce strong self−pinching in intense relativistic electron beams. Early in the pulse a thin hollow beam is formed, based on evidence of electrons striking the anode. This hollow beam collapses, accelerating toward the diode axis with velocities (1 to 5 mm/nsec) which depend locally on the anode material. An efficient and stable pinch, less than 3 mm in diameter, is formed at the anode. In the center 0.1 cm^2, the power rises to 10^{11} W in less than 3 nsec. About 50% of the total diode energy (~9 kJ) is dissipated within the pinch region. (auth)

26933 ION-EXCITED NICKEL KL^N SATELLITE X-RAY SPECTRA. Jundt, F. C. (Univ. of Rochester, NY); Nagel, D. J. Phys. Lett., A; 50A: No. 3, 179-180(2 Dec 1974).

Ni Kα spectra from 61 MeV Ni → Ni collisions were measured with a transmission crystal (Cauchois) X-ray spectrometer. Kα satellite peak spacings computed from Hartree-Fock-Slater theory depart significantly from experiment with increasing atomic number. (auth)

26934 INTENSE ION BEAMS. Green, T. S. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Rep. Progr. Phys.; 37: No. 10, 1257-1344(1974).

In recent years the requirements for higher current ion beams have increased notably in a wide area of applications. To meet these requirements it has been necessary to develop a better understanding of the three main components of ion beam systems, namely the plasma source in which ions of the species needed can be produced at controlled rates with spatial and temporal uniformity, the extraction electrode systems for formation of low divergence and low emittance ion beams, and the transport of the ion beams in the presence of possible high space charge forces.

In this review, developments in these areas are discussed with the objective of indicating the advances in understanding the basic processes which are important. (auth)

26935 CHARACTERISTICS OF γ BACKSCATTERING FROM TARGETS BOMBARDED BY MONOENERGETIC ELECTRON BEAMS. Antonov, Yu. N.; Kitler, Yu. V.; Kudinov, V. V.; Pyatnov, E. G.; Smirnov, V. V.; Tsygankov, E. A. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 148-150 (1974). (In Russian).

The results of the calculation and measurement of the intensity and energy spectrum of γ radiation released, at an angle ≃160° with respect to the incident electron beam, from targets with finite thickness and different atomic numbers, were reported. Results were given for Al, Fe, and Pb. (JSR)

26936 ELECTRON CORRELATION AND ELASTIC SCATTERING CROSS SECTIONS FOR He. Banyard, K. E.; Seddon, G. J. (Johns Hopkins Univ., Baltimore). J. Phys., B (London); 8: No. 1, 20-24(11 Jan 1975).

The systematic introduction of electron correlation into the groundstate description of He is examined from the viewpoint of its influence on the elastic scattering cross sections for the projectiles e^-, H^+, H, He^+ and Li^{++} when determined within the first Born approximation. (auth)

Atomic and Molecular Properties

Refer also to abstracts 26385, 26911, 26979, 26990, 27014, 27441, 28901, and 28904.

26937 X-RAY PHOTOEMISSION STUDY OF THE OUTERMOST LEVELS OF THE RARE EARTH METALS. Baer, Y.; Busch, G. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkoerperphysik). J. Electron Spectros. Relat. Phenomena; 4: No. 5, 611-626(Nov 1974).

From international conference on electron spectroscopy; Namur, Belgium (16 Apr 1974).

Standard X-ray photoemission technique has been applied to the study of 4f and valence states of the complete lanthanide series. The energy range of 15 eV below the Fermi level is very rich in peaks and structures. Apart from the valence band, which has a relatively weak intensity, all the features observed in the spectra are due to the different final states $4f^{n-1}$ which can be formed by removing one electron from the initial state $4f^n$. The relative intensities of the allowed final states in photoemission are given by the squared fractional parentage coefficients, which have been calculated. The energy separation between the different states can be taken from ultraviolet absorption spectra and their position relative to the Fermi level compared to a recent calculation (Herbst et al.). This analysis explains very well the detailed 4f structures observed in the spectra of all rare earth metals. On the other hand, the spectra obtained by standard techniques are not quite suitable to study valence states. This is mainly due to the X-ray satellites and to the $K\alpha_{1,2}$ line width. In order to eliminate these obstacles an X-ray monochromator has been developed for the Al line. A total instrumental line width of 0.3 eV or better (determined from the sharpness of metal Fermi edges) has been achieved. (auth)

26938 SEMICLASSICAL TREATMENT OF ELECTRONIC TRANSITIONS IN MOLECULAR COLLISIONS: THREE-DIMENSIONAL $H^+ + D_2 \rightarrow HD^+ + D$. Lin, Y. W.; George, T. F.; Morokuma, K. (Rochester Univ., N. Y. (USA). Dept. of Chemistry). Chem. Phys. Lett.; 30: No. 1, 49-53(1 Jan 1975).

A semiclassical study is carried out for the three-dimensional reaction $H^+ + D_2 \rightarrow HD^+ + D$, which involves an electronic transition from the ground to the first excited singlet state of the H_3^+ system. The potential energy surfaces corresponding to the two singlet states exhibit an avoided intersection, and they are analytically continued into the complex nuclear coordinate plane. S-matrix elements in the classical limit are computed from complex-valued classical trajectories which propagate on the analytically continued surfaces and switch surfaces continuously at the complex intersection. These elements are computed for the transition from the ground rotational and vibrational states of D_2 to the ground rotational and first excited vibrational states of HD^+ for zero total angular momentum and for energies in the range from 4.0 eV to 5.0 eV relative to the bottom of the D_2 well on the lower surface. (auth)

26939 A SINGLE-CENTER EXPANSION FOR H_2^+ WAVEFUNCTIONS. Dunlop, B. I. (The Johns Hopkins University, Silver Spring, Maryland, USA). Chem. Phys. Lett.; 30: No. 1, 39-42(1 Jan 1975).

A single-center expansion for the wavefunction of an electron in the field of two identical fixed nuclei is investigated using hydrogen-atom-like bound state wavefunctions. Inversion symmetry is used, and for a truncated basis set an upper bound on the energy is obtained. This method is exact for zero and infinite nuclear separations, and the H_2^+ ground electronic energy eigenvalue is obtained to within 0.4%. (auth)

26940 SOME REMARKS ABOUT A GENERALIZED SCF COUPLING OPERATOR OPEN SHELL THEORY. Carbo, R.; Gallifa, R.; Riera, J. M. (Instituto Quimico de Sarria, Barcelona (Spain)). Chem. Phys. Lett.; 30: No. 1, 43-48(1 Jan 1975).

Li and He atomic systems are studied from the point of view of a general monoconfigurational Hartree–Fock coupling operator formalism. As a consequence, it is found that Lagrange multiplier hermitean conditions should be fulfilled in those electronic systems where hermiticity is not present by symmetry reasons, as in the Li ground state and the He first excited singlet. An additional condition is also needed when an excited state of the same symmetry and multiplicity of the ground state should be calculated, as in He, allowing application of the variational principle to the excited state energy functional. Without this condition, the monoconfigurational Hartree–Fock procedure will lead to unphysical energies. In semi-empirical calculations, however, the hermitian condition may be relaxed without provoking appreciable errors. The NO_2 molecule is analyzed within the CNDO framework to prove this possibility, which simplifies the treatment. (auth)

26941 NOTE ON THE LAMB SHIFT FOR HELIUM-LIKE ATOMS. Aashamar, K. (Univ. of Oslo). Phys. Norv.; 7: No. 3, 169-171(1974).

The Lamb shift contributions ΔI_Δ to the ionization potentials of the ground state of helium-like atoms are re-examined, taking into account all terms of relative order α^3. The calculations are carried out using Hylleraas wave functions. The results tend to reduce the existing discrepancy between theory and experiment for BeIII and CV. They also demonstrate that more accurate determinations of the "average excitation energies" κ_0 (and possibly estimates of higher-order QED corrections as well) are desirable in order to remove the discrepancy completely. (auth)

26942 EFFECT OF VACANCY IN ELECTRONIC SHELLS ON THE ENERGY OF A HARD X-RAY LINE. Karaziya, R. I.; Grabauskas, D. V.; Kiselev, A. A. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 14: No. 2, 235-247(1974). (In Russian).

A method to determine the energy shift of the x-ray line due to single ionization of an atom is proposed. The method helps to analyze the chemical shifts and the satellite lines from the same point of view. The shifts due to electron removal from various shells can be determined from the solutions of Hartree–Fock equations for two configurations with vacancies in the inner shells. The shifts of the K_α-lines in atoms at $35 \leq Z \leq 58$ are found. It is shown that the energy of the line can either increase or decrease because of the presence of vacancy in an inner shell. (auth)

26943 NOVEL IDENTITIES FOR SIMPLE N-J SYMBOLS. Dunlap, B. I.; Judd, B. R. (Johns Hopkins Univ., Baltimore). J. Math. Phys. (N. Y.); 16: No. 2, 318-319(Feb 1975).

A number of identities involving 3-j, 6-j, and 9-j symbols in combinations not commonly encountered in angular momentum theory are established and briefly discussed. (auth)

26944 DEGENERACIES IN ENERGY LEVELS OF QUANTUM SYSTEMS OF VARIABLE DIMENSIONALITY. Herrick, D. R. (Bell Labs., Murray Hill, NJ). J. Math. Phys. (N. Y.); 16: No. 2, 281-283(Feb 1975).

Introduction of variable dimensionality to the Schrödinger equation gives rise to interdimensional degeneracies in the energy levels of one-, two-, and three-electron atoms and molecules. In all cases the degeneracies result from a factorization of the wave function into a product of a "radial" type function times an "angular" type function. Scaling of the orbital angular momentum quantum number in the one-electron radial equation to obtain "excess angular momentum" is shown to be equivalent to a variation in dimensionality. (auth)

26945 ISOTOPE EFFECTS IN THE QUENCHING OF ELECTRONICALLY EXCITED ATOMS. III. Quenching of $I(5^2P_{\frac{1}{2}})$ by HD. Butcher, R. J.; Donovan, R. J.; Strain, R. H. (Univ. of Edinburgh, Eng.). J. Chem. Soc., Faraday Trans., II; 70: No. 11, 1837-1846(1974).

Spin-orbit relaxation of $I(5^2P_{\frac{1}{2}})$ by HD has been investigated using time-resolved atomic absorption spectrophotometry. The thermally averaged cross-section for relaxation by HD has been determined as $(2.1 \pm 0.3) \times 10^{-18}$ cm^2 (at 293°K), which is three

times larger than the cross section for H_2 and which in turn is 92 times greater than that for D_2. The results strongly suggest that energy transfer proceeds via resonant processes involving electronic → vibration + rotation energy exchange. Isotope effects observed in the quenching of $Tl(6^2P_{\frac{1}{2}})$ and $Te(5^3P_{1,0})$ are also discussed and it is proposed that "selection" or "propensity" rules control the changes in rotational state and that long range multipolar coupling may be involved when resonant transfer is possible. Tentative values for a number of single channel cross sections are presented. (auth)

26946 ENERGY BAND STRUCTURE AND SPECTROSCOPIC PROPERTIES OF BERYLLIUM. Nilsson, P. O. (Chalmers Tekniska Hoegskola, Goteborg); Gustaffson, T.; Arbman, G. J. Phys., F (London); 4: No. 11, 1937-1950(Nov 1974).

The band structure of beryllium has been calculated with the APW method using a local exchange-correlation potential. Comparisons between measured spectroscopic properties and quantities derived from the band structure indicate that the energy eigenvalues are correct within 0.5 eV or better in a region of 5 eV around the Fermi level. (auth)

26947 EFFECTS OF EXCITATION MECHANISMS ON SPECTRAL PROFILES IN HELIUM. Malvern, A. R.; Nichol, J. L.; Stacey, D. N. (Oxford Univ.). J. Phys., B (London); 7: No. 18, L518-L521(21 Dec 1974).

Spectral profiles of λ492.2 nm, λ501.5 nm and λ504.7 nm have been studied under high resolution and show effects due to excitation mechanisms. This suggests a new explanation of the anomalous behavior of resonance-broadened helium lines observed in earlier experiments. (auth)

26948 HIGH RESOLUTION MEASUREMENTS OF ISOTOPE SHIFTS AND HYPERFINE SPLITTING FOR YTTERBIUM USING A CW TUNABLE LASER. Broadhurst, J. H.; Cage, M. E.; Clark, D. L.; Greenlees, G. W.; Griffith, J. A. R.; Isaak, G. R. (Univ. of Minnesota, Minneapolis). J. Phys., B (London); 7: No. 18, L513-L517(21 Dec 1974).

The hyperfine structure and isotope shifts of the $^1S_0-{}^3P_1$ intercombination line of Yb I (5556 Å) have been measured by observing the resonant scattering of light from a CW tunable dye laser incident on a collimated atomic beam. Results for all the stable isotopes of Yb are reported with an accuracy of about ±0.6 MHz (±0.02 mK). Improved relative isotope shifts are obtained, and the hyperfine anomaly of $^{171,173}Yb$ is also calculated. (auth)

26949 ELECTRON DENSITY AT THE NUCLEUS AND THE LAMB SHIFT OF ^3P LEVELS OF TWO-ELECTRON IONS. Ermolaev, A.M. (Department of Applied Mathematics and Theoretical Physics, The Queen's University of Belfast, Belfast BT7 1NN, Northern Ireland). Phys. Rev. Lett. 34: No. 7, 380-383 (17 Feb 1975).

The Lamb shifts of the 2^3S and 2^3P_1 levels in He I and Li II have been calculated by a method of effective-oscillator-strength sums. The computed shifts are in good agreement with experiment. For Li II, the theoretical Lamb shift of the 2^3P_1 level is $+0.291\pm0.041$ cm^{-1} to be compared with the experimental value of $+0.230\pm0.060$ cm^{-1} derived from the $2^3S-2^3P_1$ interval measured by Bacis and Berry. A significant Lamb shift of ^3P levels is attributed to an anomalously low electron density at the nucleus in these states. (auth)

26950 MEASUREMENT OF THE HYPERFINE STRUCTURE OF $2^2P_{1/2}$ STATE IN HYDROGEN. Lundeen, S.R.; Jessop, P.E.; Pipkin, F.M. (Lyman Laboratory, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 34: No. 7, 377-380 (17 Feb 1975).

The separated-oscillatory-field technique of subnatural-linewidth rf spectroscopy has been used to completely resolve the hyperfine structure of the $2^2P_{1/2}$ state of hydrogen. The three-component $2^2S_{1/2}-2^2P_{1/2}$ resonance observed in zero magnetic field was fitted by a superposition of numerically obtained line profiles to determine the hyperfine splitting of the $2^2P_{1/2}$ state. The result is 59.22(14) MHz. (auth)

26951 DENSITY FUNCTIONAL FORMULATION OF COLLISIONAL POLARIZABILITIES: APPLICATION TO HOMONUCLEAR NOBLE GAS DIATOMS. Heller, D.F.; Harris, R.A.; Gelbart, W.M. (Department of Chemistry, University of California, Berkeley, California 94720). J. Chem. Phys. 62: No. 5, 1947-1953 (1 Mar 1975).

We apply the general density functional formalism for electron gases in external fields to the specific case of electric susceptibilities of interacting closed shell systems. Computations are presented for the parallel and perpendicular components of the incremental polarizability tensors of He_2, Ne_2, and Ar_2, as functions of internuclear distance. In the case of He_2 our results can be compared with recent coupled Hartree-Fock calculations. For all three of the light noble gases we have evaluated the thermal averages of the pair polarizability components which correspond to the second dielectric virial coefficients and low-pressure light depolarization ratios: Agreement with experimental data is found to be very good. The dependence of these calculated collision-induced optical properties on interatomic potentials and the long-range behavior of the pair polarizability are considered in detail. (auth)

26952 APPLICATION OF RAYLEIGH-SCHRÖDINGER PERTURBATION THEORY TO THE HYDROGEN ATOM. III. Gray, B.F.; Gonda, I. (School of Chemistry, University of Leeds, Leeds LS2 9JT England). J. Chem. Phys. 62: No. 5, 2007-2008 (1 Mar 1975).

It is shown that energies calculated for the hydrogen atom by enclosing it in a spherical box with radius R and treating the Coulomb attraction as a perturbation are convergent for small R and agree with previously obtained exact results. This method is useful for calculating the energies of systems at high pressure where these can be stimulated by confinement to a small box. (AIP)

26953 TESTS OF THE FINAL SURFACE ELECTROSTATIC INTERACTION IN BEAM-TILTED-FOIL EXPERIMENTS. Berry, H.G. (Department of Physics, The University of Chicago, Chicago, Illinois 60637); Curtis, L.J.; Schectman, R.M. Phys. Rev. Lett. 34: No. 9, 509-512 (3 Mar 1975).

We present a series of new measurements of orientation and alignment in the beam-tilted-foil source designed to test the final surface electrostatic-interaction theory proposed by Eck. We find that the predictions of the model in its simplest form are not borne out by the data. (auth)

26954 RELATIVE VALUES OF OSCILLATOR STRENGTHS FOR SPECTRAL LINES OF DY I. Penkin, N. P.; Komarovskii, V. A.; Smirnov, V. V. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 3, 223-224(Sep 1974).

Translated from Opt. Spektrosk; 37: No. 3, 393-395(Sep 1974).

The relative values of the oscillator strengths of 69 spectral absorption lines in Dy I were measured by Rozhdestvenskii's hook method. The lines were located in the 2600 to 6600 Å region and are produced by transitions from the three lower levels $^5I_{8,7,6}$ of the ground term of the even configuration $4f^{10}6s^2$ and from the lowest level of the odd configuration $4f^95d6s^2$. (auth)

26955 STURMIAN EXPANSIONS OF GREEN'S FUNCTIONS FOR SIMPLEST SYSTEMS. Khristenko, S. V. (Inst. of Chemical Physics, Moscow). Teor. Mat. Fiz.; 22: No. 1, 31-45(Jan 1975). (In Russian).

Sturmian expansions of Green's functions for a number of physical models, such as the generalized Kepler problem, nonrelativistic as well as relativistic hydrogen atom, harmonic oscillator and Morse oscillator, are obtained. A general scheme for the construction of complete sets of Sturmian functions is considered. It includes as a particular case the problem previously investigated, where the eigenvalue is the strength of the potential. (auth)

26956 AUTOIONIZATION AND DISSOCIATION OF HYDROGEN MOLECULES PRODUCES IN $H_2^+ + H_2$ CHARGE TRANSFER COLLISIONS. Band, Y. B. (Univ. of Chicago). J. Phys., B (London); 7: No. 15, 2072-2083(21 Oct 1974).

The decay of H_2 molecules produced by charge transfer reactions in $H_2^+ + H_2$ collisions is investigated. Dissociation processes are observed to be important in explaining the experimentally observed total cross section for charge transfer. Experiments on the highly excited states of hydrogen molecules produced in the above charge transfer collisions are analyzed and compared with theoretical arguments on the decay of Rydberg states of molecules. Vibrational autoionization is shown to be an important factor in the interpretation of these experiments. The Rydberg states with $1 \geq 3$ are shown to be responsible for the observed decay time of 10^{-7}s and higher for some of the excited hydrogen molecules. Rotational autoionization is ruled out as an important decay mechanism for the H_2 states examined. (auth)

26957 NON-ADIABATIC CALCULATIONS FOR H_2^+, HD^+, AND D_2^+. Bishop, D. M. (Univ. of Ottawa). Mol. Phys.; 28: No. 6, 1397-1408(Dec 1974).

Non-adiabatic calculations are reported for the two lowest non-rotational energy levels of H_2^+, HD^+ and D_2^+. They are lower in energy than previously published non-adiabatic calculations and the dissociation energies are 21 379.28, 21 515.99 and 21 711.51 cm^{-1} for H_2^+, HD^+ and D_2^+, respectively. Certain approximate ratios for the non-adiabatic corrections are discussed and shown to be in reasonable agreement with the exact ratios. It is suggested that the Unsöld average-energy denominator for H_2^+ should lie between 2.6×10^5 and 3.6×10^5 cm^{-1}. (auth)

26958 MODEL POTENTIAL CALCULATIONS OF RESONANCE STATES IN THREE-ELECTRON ATOMS. Barden, I. R.; Bottcher, C.; Schneider, K. R. (Univ. of Manchester, Eng.). J. Phys., B (London); 8: No. 1, L1-L4(11 Jan 1975).

A model potential method has been developed for one or more electrons outside a ^2S core and applied to calculate the position and widths of auto-ionizing states. The phase shifts for e + He and e + Li^+ scattering predicted by the model are in good agreement with other theories and with experiments while the widths of He^- ($1s\,2s^2\ ^2S$) resonance is 8 MeV, also in agreement with experiment. (auth)

26959 NON-ADIABATIC 2s–2p STATE MIXING IN METASTABLE HYDROGEN BY ELECTRIC FIELDS. Brouillard, F.; van Wassenhove, G. (Univ. Louvain, Belgium). J. Phys., B (London); 7: No. 17, 2308-2314(1 Dec 1974).

The evolution of a (n = 2) hydrogen atom passing through a linearly increasing or decreasing electric field is calculated in a three-state approximation. The observable fraction of $2p_{\frac{1}{2}}$, $2s_{\frac{1}{2}}$ and $2p_{\frac{3}{2}}$ quantum state in the resulting coherent mixture is calculated. The amplitude of the oscillations, which appear when the field parameters are varied, is shown to depend only on the rate of change of the field, as seen by the atom. Maps of oscillation amplitudes and average values are given for the metastable atom. Comparison is made with the sudden and adiabatic approximations. (auth)

26960 EXPOSITION OF ATOMIC PAIR CORRELATION FUNCTIONS AND ASSOCIATED ENERGIES OBTAINED BY ANALYSIS OF CORRELATED WAVE FUNCTIONS. Banyard, K. E.; Taylor, G. K. (Univ. of Leicester, Eng.). Phys. Rev., A; 10: No. 6, 1972-1980(Dec 1974).

Using Sinanoglu's method of successive partial orthogonalizations, pair correlation functions were extracted from the energetically accurate configuration-interaction wave functions of Weiss for a series of two-, three-, and four-electron ions. For selected systems, the pair correlation functions are examined by constructing contour diagrams which explicitly reveal the relative corrections to the Hartree-Fock wave functions brought about by inclusion of pairwise correlation interactions. For each pair function, an associated pair correlation energy is evaluated. The characteristics of both the pair functions and the pair energies are examined together with their Z dependence for a constant number of electrons and their dependence upon the number of electrons for constant Z. The small differences which occur between the K shells for ions of a constant Z were rationalized in terms of an orthogonality requirement, while the slight but smooth variation of the K-shell pair energies with Z has enabled one to comment on the stability of the ion He^-. The pictorial representation has highlighted differences between the L- and K-shell correlation effects within the Be-like ions. In particular, the large degree of angular correlation in the L shell, brought about by the near degeneracy of the 2s and 2p orbitals, is clearly apparent from the contour diagrams. Also revealed is a nearly linear variation of the L-shell pair energies with Z. Comparison of the pair energies for the four-electron ions with the results of others shows that the wave functions analyzed provide a good description of the correlation effect within the K- and L-shells, the description of the latter being superior to that of the former. The intershell correlation behavior, however, is accounted for only very approximately. For the Be-like series as a whole, the L-shell pair energies are expected to be highly reliable. (auth)

26961 WIDTHS OF THE L X-RAY LINES OF THE RARE-EARTH ELEMENTS. Salem, S. I.; Lee, P. L. (California State Univ., Long Beach). Phys. Rev., A; 10: No. 6, 2033-2036(Dec 1974).

An improved version of a single-crystal high angle goniometer and a NaI scintillation detector were used to measure the widths of the $L\alpha_{1,2}$, $L\beta_{1-4}$, and $L\gamma_1$ x-ray lines of the elements $58 \leq Z \leq 74$ and the widths of the less prominent lines $L\beta_{15}$, LI, $L\eta$, and $L\gamma_1'$ of several elements in the same group. The x-ray spectrum of these elements was produced by bombarding them with an electron beam of constant energy and flux, and a computer program was used to unfold the physical widths of their emission lines. These results, as well as the previously reported values of linewidths of the higher-Z elements, are compared with the most recent theoretical predictions. (auth)

26962 HIGHER-ORDER EFFECTS IN MULTIPHOTON TRANSITIONS. Choudhury, B. J. (Univ. of Manitoba, Winnipeg). Phys. Rev., A; 10: No. 6, 2070-2077(Dec 1974).

A general analytic result was obtained for calculating any higher order correction to the transition amplitude for N-photon absorption by writing the time-dependent perturbation theory in the S-matrix form. In obtaining this result, I have made use of the concept of average energy as has been defined by Bebb and Gold. A formal expression was obtained for the upper bound of the higher-order correction and the results are discussed for the case of the hydrogen atom. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 27589, 27645, and 27787.

26963 NUCLEAR AUGER EFFECT IN MUONIC ATOMS. Lohs, K. P.; Wolschin, G. W. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik); Huefner, J. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Phys., A; 236: No. 2, 457-468(30 Dec 1974).

In a muonic atom electromagnetic transitions proceed via emission of X-rays, electrons from the atomic cloud (Auger electrons), or neutrons from the nucleus (nuclear Auger effect). The neutron spectrum is calculated for muonic ^{207}Pb and ^{209}Bi within a microscopic theory of nuclear reactions. The compound nucleus mechanism is dominant. Most of the neutrons arise from the E2 transition $3d \rightarrow 1s$. Agreement between experiment and calculation is achieved to within a factor of 2. (auth)

26964 POSITRONIUM REACTIONS WITH DIAGMAGNETIC ORGANIC MOLECULES. Madia, W. J.; Nichols, A. L.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Appl. Phys.; 3: No. 3, 189-191(Mar 1974).

1 fig.; 2 tabs.; 5 refs.

Rate constants for the interaction of ortho-positronium atoms with a series of diamagnetic organic compounds have been determined. Nitrated aromatic molecules interact far more readily with ortho-positronium than do nitrated aliphatic molecules. The observed rate constants for the aromatic molecules show a distinct dependency on the nature of the substituents and their relative positions in the aromatic ring. This dependency may be attributed to steric interactions which influence the relative electron charge density on the atoms in the molecule and alter the molecular energy levels. (auth)

26965 DOPPLER BROADENING OF POSITRON ANNIHILATION PHOTONS IN METALS. Barshay, S. S.; Leber, R. E.; Lambrecht, R. M. (Brookhaven National Lab., Upton, N. Y. (USA). Dept. of Chemistry). Appl. Phys.; 5: No. 1, 67-70(Oct 1974).

3 figs.; 17 refs.

The Doppler broadening of positron annihilation photons was measured in 17 metals. A model which considers the positron lifetime spectra in metals to be composed of terms for annihilation with conduction and core electrons and surface centers of low electron momentum is used to correlate calculated core annihilation rates with the Doppler lineshape. Ta metal was doped with defects with high-energy implantations of $^{14}N^{+4}$ ions at variable doses. Differences in the Doppler linewidths were ascribed as being principally a reflection of the probability of annihilation with core electrons relative to annihilation with conduction electrons. (auth)

26966 POSITRONIUM QUENCHING REACTIONS AND DIFFUSION IN SOLUTIONS. Tao, S. J.; Kelly, T. M.; Chuang, S. Y.; Wilkenfeld, J. M. (New England Inst. for Medical Research, Ridgefield, Conn. (USA)). Appl. Phys.; 3: No. 1, 31-35(Jan 1974).

From 3rd international conference on position annihilation; Otaniemi, Finland (7 Aug 1973). 5 figs.; 1 tab.; 16 refs.

The temperature effect on positronium quenching rates for p-benzoquinone and iodine in several solvents was determined. The quenching rate constant k_1 follows a $k_1 \sim 1/\eta$ relationship better than the $k_1 \sim T/\eta$ predicted by ordinary theory. A simple theoretical treatment based on diffusion theory shows that the temperature T of the solute, positronium, may not be the same as the temperature of the solvent if the positronium is not fully thermalized. This temperature is found to be about twice the room temperature for the solvents investigated. The findings further support the theory that positronium reactions are "diffusion controlled" in liquid solutions. The activation energies of all the positronium reactions studied are either negligible or less than 0.1 eV. (auth)

26967 MANIFESTATION OF PERIODICITY IN π^- MESON CAPTURE BY HYDROGEN IN SATURATED HYDRIDES. Gol'danskii, V. I.; Zatsepina, N. N.; Tupitsyn, A. F.; Kholodov, N. I. (Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR; 217: No. 1, 56-58(1974). (In Russian).

The probability of π^- meson capture $W_{ZH_n} = (na_{H-Z}Z^{-2})/(n + Z)$ was calculated from previous experimental data and the results showed that the coefficient a_{H-Z} increases to the middle of the periodic table for elements of the second period and then decreases. The mechanism of the Z–H bond that is responsible for this pattern is discussed. The character of the dependence of a_{H-Z} on Z is similar to the pattern found in the probability of μ^- meson capture in normal oxides. (JSR)

26968 HADRONIC VACUUM–POLARIZATION CORRECTIONS IN MUONIC ATOMS. Sundaresan, M.K.; Watson, P.J.S. (Department of Physics, Carleton University, Ottawa, Canada K1S 5B6). Phys. Rev. D 11: No. 1, 230-231 (1 Jan 1975).

The contributions of hadronic intermediate states to muonic–atom energy levels are calculated, using a recent approximation due to Adler. (auth)

26969 COMPLEX DEPENDENCE OF THE POSITRON ANNIHILATION RATE OF METHANE GAS DENSITY AND TEMPERATURE. McNutt, J.D.; Summerour, V.B.; Ray, A.D.; Huang, P.H. (Department of Physics, The University of Texas at Arlington, Arlington, Texas 76019). J. Chem. Phys. 62: No. 5, 1777-1789 (1 Mar 1975).

Annihilation rates have been measured for positrons in methane gas at temperatures of 22, 4.5, −28, and −50°C at densities in the range $6.6\times10^{-4}-1.1\times10^{-1}$ g/cm³, in 22.5 and −28°C methane gas as a function of applied electric field strength and gas density, and in 22°C methane–argon gas mixtures as a function of argon concentration. A complex dependence of the slow positron annihilation rate on methane density and temperature was observed. The orthopositronium annihilation rate became temperature dependent at high densities. Both the positron–methane and the orthopositronium–methane annihilation rates were found to be independent of argon concentration in the gas mixtures. Electric fields produced a decrease in the slow positron annihilation rates, but had no measurable effect on the orthopositronium rates. The annihilation behavior of slow positrons is discussed in terms of several annihilation models, and empirical analyses of the data in terms of these models are presented. Only the single–stage formation of a positron–methane complex can account for all the observed phenomena. (auth)

26970 POSITRON MEAN LIFETIMES IN ANNEALED METALS. MacKenzie, I.K.; Jackman, T.E.; Thrane, T. (Department of Physics, University of Guelph, Guelph, Ontario, Canada N1G 2W1). Phys. Rev. Lett. 34: No. 9, 512-513 (3 Mar 1975).

Centroid shift analysis of time spectra show that mean lifetimes range from 106 psec in Fe to 415 psec in Cs and have a systematic dependence on atomic number. (auth)

26971 POSITRONIUM IN MOLECULAR SUBSTANCES. Tao, S. J. (New England Inst. for Medical Research, Ridgefield, Conn. (USA)). Appl. Phys.; 3: No. 1, 1-7(Jan 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

The progress of research into the behavior of positronium in molecular substances in the last several years is reviewed. The Ps atom can be treated as a solute in a liquid. The repulsive exchange force is the dominant force which reacts against the van der Waals attractive force. One of the most useful general relationships found is the one between the pick-off quenching rate and the surface tension of the liquid. The pick-off quenching rate is found, in general, to be an additive property of the functional groups of a molecule. The quenching of the o-Ps atom by an active quenching agent in an inert solvent has been found to be primarily diffusion controlled. Some deviations from the simple Arrhenius equation have been found. For gases, more theoretical work on the collision problems of Ps with atoms or molecules is needed. For amorphous molecular solids, it is likely that the property of pick-off quenching of o-Ps is similar to that in liquids. However, in crystalline molecular solids, the situation is quite different. A few definite cases have been found where a Ps atom does not form or exist. (auth)

26972 POSITRON STATES IN ALKALI HALIDE SINGLE CRYSTALS. Aref'ev, K. P.; Vorob'ev, S. A.; Prokop'ev, E. P. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 76-79(1974). (In Russian).

A detailed examination was made of annihilation decay of positron states in real alkali halide single crystals with a defective structure. The representations on the exciton-positron states in the crystalline matrix and close to the lattice defects were analyzed. On this basis expressions were obtained for the yield of three-quanta decay and the intensity of the component of two-quanta annihilation, in agreement with known experimental data. It was shown that the greatest contribution to the three-quanta decay is given by the exciton orthopositron state, located in the region of the defect. (tr-auth)

26973 POSITRONIUM ATOM IN POLYMERS. Bartenev, G. M.; Buchikhin, A. P.; Gol'danskii, V. I.; Tsyganov, A. D. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 217: No. 3, 536-539(1974). (In Russian).

A model, analogous to the model of positron capture by monovacancies in metals, was proposed to describe the process of annihilation of positrons in solid molecular substances. The model was compared with experimental data and the agreement was good for polyethylene, teflon, and glycerine. (JSR)

Collision Phenomena

Refer also to abstracts 25949, 26956, 26961, and 27474.

26974 (AD-782048) APPLICATION OF FADDEEV EQUATIONS TO HEAVY PARTICLE REACTIONS. Final Report, 1 June 1971–1 June 1973. Wolf, F. A. (General Technologies Corp., Springfield, Va. (USA)). Jun 1974. 52p. (AFOSR-TR-74-1145). NTIS $3.75.

The report summarizes results of studies concerning the application of Faddeev equations to heavy-particle reactions, the nearest resonance method for calculating charge transfer cross sections, and the probability map study of curve crossing in ion–molecule charge transfer collision trajectories. (auth)

26975 (AD-787527) QUANTUM STUDIES OF REACTIVE SCATTERING. Final Report, 1 August 1971–31 July 1974. Light, J. C. (Army Research Office, Durham, N. C. (USA)). 30 Sep 1974. 8p. NTIS $3.25.

Two research areas were studied during the tenure of and with the support of this grant: direct calculation of the reduced (one electron) density matrix (Hartree-Fock approximation) for model and atomic systems; and the general area of gas phase collision processes, both inelastic and reactive scattering by classical and quantum methods. Progress in each area is briefly described. (auth)

26976 (N-74-27345) CALCULATION OF THE TOTAL ELECTRON EXCITATION CROSS SECTION IN THE BORN APPROXIMATION USING SLATER WAVE FUNCTIONS FOR THE Li(2s → 2p), Li(2s → 3p), Na(3s → 4p), Mg(3p → 4s), Ca(4s → 4p), and K(4s → 4p) EXCITATIONS. Simsic, P. L. (Toledo Univ., Ohio (USA)). 1974. 65p. (NASA-CR-138906). NTIS $6.25.

Thesis.

Excitation of neutral atoms by inelastic scattering of incident electrons in gaseous nebulae were investigated using Slater wave functions to describe the initial and final states of the atom. Total cross sections using the Born approximation are calculated for: Li(2s yields 2p), Na(3s yields 4p), k(4s yields 4p). The intensity of emitted radiation from gaseous nebulae is also calculated, and Maxwell distribution is employed to average the kinetic energy of electrons. (STAR)

26977 (RLO-1388-263) ELECTRON LOSS IN HIGH-ENERGY OXYGEN–ION COLLISIONS. Burch, D.; Wieman, H.; Ingalls, W. B. (Washington Univ., Seattle (USA). Dept. of Physics). 1973. 10p. Dep. NTIS $4.00.

The 90° electron spectra from oxygen-ion single collisions with Ar were measured at energies of 17 to 41 MeV and charge states of 3+ to 8+. A broad peak in the spectra is observed and identified as electrons lost from the incident ion. A simple model of the electron-loss process is described which supports the identification. (auth)

26978 ON OSCILLATIONS OF AUTOIONIZATION STATE EXCITATION FUNCTIONS IN SLOW ION–ATOM COLLISIONS. Bydin, Yu. F.; Vol'pyas, V. A.; Godakov, S. S. (Leningradskij Ehlektrotekhnicheskij Inst. (USSR)). Phys. Lett., A.; 50: No. 4, 239-240(11 Dec 1974).

Oscillations equidistant in the reciprocal velocity of relative motion were observed in the excitation functions of discrete electron groups due to the decay of the autoionization states of colliding particles. They can be accounted for in the framework of the Rosenthal–Foley model. (auth)

26979 EXCITATION CROSS SECTIONS OF $1^1S \rightarrow m^1P$ TRANSITIONS IN HELIUM BY ELECTRON IMPACT. Narain, U.; Chandra, S. (Atomic and Molecular Physics Research Group, Physics Department, Meerut College, Meerut, U. P., India). Physica; 77: No. 3, 623-626(1 Nov 1974).

The cross sections for electron-impact excitation of ground-state helium to the m^1p (m = 2 to 5) excited states have been calculated in the energy range 0.2–20 keV, semiempirically. Results indicate small corrections with respect to existing data. (auth)

26980 INVERSION OF TOTAL CROSS SECTIONS FOR REPULSIVE ION-ATOM SCATTERING IN THE CLASSICAL REGIME. II. Littmark, U. (Copenhagen Univ. (Denmark). H. C. Oersted Inst.). Physica; 77: No. 3, 619-622(1 Nov 1974).

A previously derived formula for inversion of incomplete total scattering cross sections into ion–atomic potentials is generalized to take into account total cross sections measured

as a function of both ion energy and aperture. The formula allows an estimate of the error of the potential determined. Analysis of K^+-Ar cross sections of Sielanko and coworkers shows that measurements of this kind are especially valuable, not only because of the easy extension of the range in which the potential is determined, but mainly because of the decrease of the error. (auth)

26981 ELASTIC AND INELASTIC SCATTERING INTENSITIES FOR ELECTRONS FROM H_2^+ IN THE FIRST BORN APPROXIMATION. Liu, J. W.; Smith, V. H. Jr. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Chemistry). Chem. Phys. Lett.; 30: No. 1, 63-68(1 Jan 1975).

The elastic and inelastic intensities for the scattering of electrons from H_2^+ ($1s\sigma_g$) are computed in the first Born approximation by using both the exact Born–Oppenheimer wavefunction and an LCAO MO function of optimized minimal basis quality. Evaluation of the coherent X-ray scattering factor by expansion of the plane-wave operator in spheroidal coordinates is discussed in some detail. (auth)

26982 ELECTRON TRANSFER AND REACTIVE IONIZATION IN $C + O_2$ COLLISIONS IN THE ELECTRON VOLT ENERGY RANGE. Koennen, G. P.; Haring, A.; de Vries, A. E. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Chem. Phys. Lett.; 30: No. 1, 11-16(1 Jan 1975).

Cross sections for ion formation in $C + O_2$ collisions have been measured as a function of the kinematic energy up to 15 eV. Charge transfer is found to give rise to C^+, O_2^-, C^-, O_2^+, and free electrons. Five processes leading to these ions have been identified. Reactive ionization is taking place, proceeding according to three processes: $C + O_2 \rightarrow CO^+ + O + e^-$, $CO^+ + O^-$ and $CO + O^+ + e^-$. (auth)

26983 CHARGE TRANSFER REACTIONS OF H_2^+ WITH CH_4 AND Ch_2D_2 IN THE RANGE OF 6 TO 150 eV. Ardelean, P.; Mercea, V.; Ursu, D. (Inst. of Stable Isotopes, Cluj). Stud. Cercet. Fiz.; 26: No. 6, 619-622(1974). (In Rumanian).

The charge transfer reactions of H_2^+ ions with CH_4 and CH_2D_2 was studied in a perpendiculary type tandem mass spectrometer. The influence of the kinetic energy of incident ions on the secondary mass spectra is small. In the $H_2^+-CH_2D_2$ charge transfer reaction an isotope effect is observed. The relative cross section of CHD_2^+ is ~2 (at 6 eV) to ~3 (at 150 eV) times that for CH_2D^+ ion. (auth)

26984 CORRELATION EFFECTS IN ELASTIC ELECTRON–HELIUM SCATTERING. Aashamar, K.; Hambro, L. (Univ. of Oslo). Phys. Norv.; 7: No. 3, 107-112(1974).

The Born and Glauber differential cross sections for elastic electron–helium scattering were calculated using a sequence of variational target wave functions. The results show that both the Born and Glauber cross sections are rather sensitive to the approximation used for the helium bound-state function. (auth)

26985 COMPARISONS OF THICK AND THIN TARGET METHODS FOR OBTAINING X-RAY PRODUCTION CROSS SECTIONS FOR FAST ION IMPACT. McKnight, R. H.; Thornton, S. T.; Karlowicz, R. R. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Nucl. Instrum. Methods; 123: No. 1, 1-4(1 Jan 1975).

Comparisons of X-ray production cross sections obtained from thick and thin target measurements for α-particle and neon ion impact show reliable cross sections may be obtained for K and L X-rays for α-particle bombardment by using thick target techniques. Because of large self-absorption corrections, M X-ray cross sections have large uncertainties. Similar comparisons for neon ion impact show significant differences between thick and thin target measurements. (auth)

26986 SCATTERING OF He^+ IONS BY THE CORE OF THE He ATOM. Latypov, Z.Z.; Shaporenko, A.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 19: No. 7, 976-977 (Jan 1975).

The total cross sections for the following resonant processes involving electron capture and transfer of excitation energy are discussed as function of the collision energy: $He^+ + He \rightarrow He + He^+, He^*$ $(2^1S) + He \rightarrow He + He^*$ (2^1S), and He^* $(2^3S) + He \rightarrow He + He^*$ (2^3S). The similar structures of these cross sections are explained on the basis of the scattering of the projectile particles by the core of the target atom. (auth)

26987 THEORETICAL STUDY OF INELASTIC SCATTERING OF H_2 BY Li^+ ON SCF AND CI POTENTIAL ENERGY SURFACES. Schaefer, J.; Lester, W.A. Jr. (IBM Research Laboratory, San Jose, California 95193). J. Chem. Phys. 62: No. 5, 1913-1924 (1 Mar 1975).

Integral and differential cross sections for pure rotational and simultaneous rotational–vibrational excitation of H_2 by Li^+ impact have been computed following the coupled–channel formalism using two different SCF potential energy hypersurfaces and a CI hypersurface at 0.6 and 1.2 eV. Sensitivity of integral cross sections to (a) choice of *ab initio* potential energy surface and (b) expansion length of a Legendre polynomial representation of one of the energy surfaces is examined. It is seen that preparation of H_2 in the $v = 0$, $j = 2$ state leads to four– and fivefold increases in excitation cross sections to the $v = 1$, $j = i$, $i = 0,2,4$ states relative to excitation of ground state ($v = 0$, $j = 0$) H_2. Differential cross sections are reported at 1.2 eV for up to five quantum rotational and for vibrational transitions on one of the energy hypersurfaces. All angular distributions required for determining ratios (inelastic : elastic) of differential cross sections needed for comparison with recent time–of–flight experiments at 0.6 eV are computed using both SCF and CI potential energy surfaces and compared. Further comparisons are made with experiment, beyond those that have appeared to date, which indicate that a significant discrepancy at one of the three angles for which measurements are available is due to experiment. (auth)

26988 ELECTROSTATIC POLARIZATION IN THE EXCHANGE SCATTERING OF ELECTRONS OF HIGH KINETIC ENERGY. $^1S \rightarrow {}^3S$ TRANSITION IN HELIUM. SINGLET–TRIPLET EXCITATION IN CO. Klump, K.N.; Lassettre, E.N. (Department of Chemistry, Mellon Institute of Science, Carnegie–Mellon University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 62: No. 5, 1838-1841 (1 Mar 1975).

Excitation in forward scattering by electron impact of the 2^3S state in helium is studied in the kinetic energy range 100–300 eV. This extends to lower energies the investigation of Skerbele, Harshbarger, and Lassettre [J. Chem. Phys. 58, 4285 (1973)]. A minimum in the cross section is found for the first time at ~225 eV, in approximate agreement with the calculations of Huo [J. Chem. Phys. 60, 3544 (1974)]. Abnormally high cross sections in forward scattering ($\theta = 0°$) are expected (from Huo's theory) for those singlet–triplet transitions for which the orbital term symbols (like S for $^1S \rightarrow 2^3S$) are the same in ground and excited states. A search for such transitions is made in CO at 200 and 300 eV incident energies and an example is found. (auth)

26989 EXCITATION IN ELECTRON–METASTABLE HELIUM COLLISIONS. Flannery, M.R.; Morrison, W.F.; Richmond, B.L. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). J. Appl. Phys. 46: No. 3, 1186-1190 (Mar 1975).

The $2^{1,3}P$, $3^{1,3}S$, $3^{1,3}P$, $3^{1,3}D$ and $4^{1,3}P$ excitations arising from $e-He(2^{1,3}S)$ collisions are examined by application of the Born and of the Vainshtein, Presnyakov, and Sobel'man approximations. Total excitation cross sections are calculated for the above transitions for electron impact energy E up to 500 eV. Contrary to expectation, excitation to the $3^{1,3}D$ and $3^{1,3}S$ states dominate the $3^{1,3}P$ and $4^{1,3}P$ excitations except at incident energies above 100 eV. (auth)

26990 MEASUREMENTS OF PHOTON POLARIZATION AND ANGULAR CORRELATIONS FOR He^+-He COLLISIONS USING AN ION–PHOTON COINCIDENCE TECHNIQUE. Vassilev, G.; Rahmat, G.; Sievin, J.; Baudon, J. (Laboratoire de Collisions Atomiques, Université Paris–Sud, 91405 Orsay, France). Phys. Rev. Lett. 34: No. 8, 444-447 (24 Feb 1975).

The polarization of photons from the transition $3^3P \rightarrow 2^3S$ and the angular distribution of radiation from the decay $2^1P \rightarrow 1^1S$ emitted in $He^+ + He$ collisions at an incident energy of 150 eV and an ion scattering angle of 13.5° were measured by detecting the scattered ions and photons in delayed coincidence. From these measurements we conclude that the 3^3P excitation takes place through a $\Sigma-\Sigma$ radial coupling, and the 2^1P excitation, predominantly through a $\Sigma-\Pi$ rotational coupling, probably at large internuclear separation. (auth)

26991 ELECTRON LOSS IN LOW–ENERGY H^+-H (high n) MERGED–BEAM COLLISIONS. Koch, P.M.; Bayfield, J.E. (J. W. Gibbs Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. Lett. 34: No. 8, 448-451 (24 Feb 1975).

We have measured the electron–loss cross section for collisions between protons and highly excited hydrogen atoms having principal quantum numbers in the nominal n band $44 \lesssim n \lesssim 50$. The c.m. collision energy range was $0.4\ eV \leq W \leq 61\ eV$. Theoretical ionization–cross–section results are compared with the data, and are then used to unfold from the data the approximate electron–transfer cross section. Classical scaling calculations are found to be in reasonable agreement with the unfolded data, while quantal predictions are not. (auth)

26992 CHEMICAL REACTION KINEMATICS. P. 16. Crossed Beam Study of the Reaction $CH_2^+ + H_2 \rightarrow CH_3^+ + H$. Eisele, G.; Henglein, A.; Bosse, G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Sektor Strahlenchemie). Ber. Bunsenges. Phys. Chem.; 78: No. 2, 140-145(Feb 1974).

The reactions $CH_2^+ + H_2 \rightarrow CH_3^+ + H$, $CH_2^+ + D_2 \rightarrow CH_2D^+ + D$, $CHD_2^+ + H$, $CHD^+ + HD$ were investigated with respect to the energy and angular distributions of the product-ions at collision

energies between 0.54 and 13.3 eV (cm-system). An intermediate complex CH_4^+ (or $CH_2D_2^+$) is formed with a high cross section at low energies which decays into the reactants and products with a ratio of 1:2. The intensity distribution of the CH_3^+ ion in the velocity vector diagram indicates that the transition state of the dissociating complex acts as a spherical top and decays isotropically in space. The CH_3^+ ion is often formed with rotational excitation, CH_2D^+ and CD_2H^+ are formed with equal abundance at low energies. The relative abundance of CH_2D^+ at first increases with energy and simultaneously preferred forward scattering of this ion is observed. This corresponds to the transition to a stripping process. Beyond 5.5 eV, the CH_2D^+ abundance decreases because of the preferred formation of $CHD^+ + H + D$. The relative abundance of CD_2H^+ rapidly decreases into the forward direction at high energies. Below about 1 eV, a small part of the reaction enthalpy is transformed into translational energy of the products. With increasing energy, the translational exoergicity becomes increasingly negative. (auth)

26993 MOLECULAR DYNAMICS OF UNSTABLE INTERMEDIATES. Levine, R. D. (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). Ber. Bunsenges. Phys. Chem.; 78: No. 2, 111-119(Feb 1974).

Recent progress in experimental techniques has made possible the detailed study of the molecular dynamics of energy-rich polyatomic species. The development of more sensitive tools enables us to consider such questions as the lifetime distribution, the branching ratio for alternative decay modes and the energy disposal in the dissociation products. These deeper probes into the dynamics have led to a better understanding of the theory of the formation and decay of unstable intermediates. We review a unified point of view which covers both unimolecular and bimolecular collision phenomena. An important recent diagnostic tool is the distribution of energy among the dissociation products. We consider a theory of such distributions which will enable us to correlate and codify the existing data, with particular emphasis on deviations from the RRKM predictions. A measure of the deviation is provided by the introduction of the concept of entropy, thereby establishing a link between non-equilibrium statistical mechanics and the evolution of energy-rich super-molecules. (auth)

26994 PENNING EFFECT IN COLLISION WITH AN EXCITED HELIUM ION. II. Kvlividze, V. A.; Laktionov, N. V.; Svotin, P. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 3, 344-345(Sep 1974).

Translated from Opt. Spektrosk; 37: No. 3, 608-609(Sep 1974).

A general model for Penning ionization in collisions with an excited helium ion and helium, neon, argon, krypton, and xenon at 0.5 to 30 eV is considered assuming the nuclear motion to be classical. A sighting parameter method is used. The level widths, diagonal matrix elements, and the Penning ionization cross sections are found. (JFP)

26995 DEPOLARIZING COLLISIONS OF ATOMS AND THE BROADENING OF SPECTRAL LINES. Matskevich, V. K. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 3, 233-237(Sep 1974).

Translated from Opt. Spektrosk; 37: No. 3, 411-419(Sep 1974).

The influence of the Van der Waals interaction of excited atoms with unexcited atoms of an impurity gas on the spectroscopic characteristics of atomic transitions is investigated. The study is conducted with consideration being given to the degeneracy of the levels of the excited atoms. A numerical calculation of the width, line shift, and polarization characteristics of the levels is carried out for the transition between states with momentum $j = 1$ and $j = 2$. Phenomena related to the dependence of spectroscopic characteristics on the velocity of the excited atoms are examined. The possibility of applying the results to an analysis of experimental data is discussed. (auth)

26996 INELASTIC COLLISIONS BETWEEN HIGHLY EXCITED ATOMS AND INERT-GAS ATOMS. Smirnov, V. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 3, 231-232(Sep 1974).

Translated from Opt. Spektrosk; 37: No. 3, 407-410(Sep 1974).

It is shown that in collisions between highly excited atoms (principal quantum number of the excited electron of the order of 10) and inert-gas atoms a primary role in quantum transitions of the excited electron is played by the noninertiality of the motion of the center of the atom. The transitions are quantum in nature and do not lend themselves to semi-classical methods of calculation. (auth)

26997 EFFECT OF MINIMA IN THE GENERALIZED OSCILLATOR STRENGTH ON THE TOTAL IONIZATION CROSS SECTION. Manson, S. T.; Msezane, A. (Georgia State Univ., Atlanta). J. Phys., B (London); 8: No. 1, L5-L7(11 Jan 1975).

It is shown that an inflection in the total ionization cross section of an atomic subshell can occur if the generalized oscillator strength has a minimum. Results of calculations for the proton impact ionization of the 2s subshell of Cu showing this phenomenon are presented. (auth)

26998 ENERGY DISTRIBUTION OF SECONDARY ELECTRONS. I. Consistency of Experimental Data. Kim, Y. K. (Argonne National Lab., IL). Radiat. Res.; 61: No. 1, 21-35 (Jan 1975).

The energy distribution of secondary electrons ejected by fast charged particles from free atoms and molecules should show certain qualitative features according to theory. Recent electron-impact data by Opal, Beaty, and Peterson indeed exhibit these features clearly. The spectrum of fast secondaries tends to agree better with the Mott cross section rather than with the binary-encounter theory with the corrections for the initial momentum distribution of bound electrons. A method is proposed for extrapolating the secondary-electron spectra to ranges where experiment becomes difficult (e.g., for very slow and very fast secondary electrons). With this method, secondary-electron spectra can be put easily on an absolute scale, provided that reliable total ionization cross sections are available. The method applies also to the analysis of experimental data on electrons ejected by fast heavy particles, such as protons and alpha particles. (auth)

26999 FINE STRUCTURE EFFECTS IN H^+ AND D^+ CHARGE EXCHANGE WITH Xe. Benoit, C. (Paris Univ., Orsay, France); Brenot, J. C.; Pommier, J.; Barat, M.; Pollack, E. J. Phys., B (London); 7: No. 15, L424-L426(21 Oct 1974).

Preliminary differential scattering results on charge exchange into the $^2P_{\frac{1}{2}}$ and $^2P_{\frac{3}{2}}$ fine structure levels of Xe^+ in H^+ and D^+ collisions with Xe in the laboratory energy range from 120 to 712 eV are reported. Time of flight techniques used for state identification show the dominance of the $^2P_{\frac{1}{2}}$ level at low energy. Cross sections are determined, and the results interpreted in a molecular framework. (auth)

27000 COULOMB-PROJECTED BORN APPROXIMATION. V. Ionization of Helium. Geltman, S. (National Bureau of Standards, Boulder, CO). J. Phys., B (London); 7: No. 15, 1994-2002(21 Oct 1974).

The triple differential cross section for the electron impact ionization of helium is calculated in the Coulomb-projected Born approximation, including exchange. Detailed comparison is made with the ordinary Born result and with available experiment in both the coplanar and noncoplanar geometries. The agreement with experiment in almost all cases is appreciably better for the Coulomb-projected Born results than for the ordinary Born results. (auth)

27001 ELECTRON LOSS FROM AND DESTRUCTION OF FAST METASTABLE HELIUM IONS PASSING THROUGH ATOMIC HYDROGEN. Bell, K. L.; Kingston, A. E. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 15, L420-L423(21 Oct 1974).

The cross sections for electron loss from and destruction of fast metastable helium ions, $He^+(2s)$, passing through ground state atomic hydrogen are calculated using the first Born approximation. The theoretical predictions are in reasonable agreement with measurements of Gilbody and Shah (J. Phys. B. Atom. Molec. Phys.; (1974). To be submitted) (auth)

27002 NEON K X-RAY SPECTRA EXCITED BY O^{4+} AND Cl^{4+} BOMBARDMENT. Moore, C. F. (Univ. of Texas, Austin); Bolger, J.; Roberts, K.; Olsen, D. K.; Johnson, B. M.; Mackey, J. J.; Smith, L. E.; Matthews, D. L. J. Phys., B (London); 7: No. 15, L415-L417(21 Oct 1974).

Neon K x-ray spectra resulting from O^{4+} and Cl^{4+} bombardment are observed to have dissimilar Kα satellite intensities. These results are in contrast to similar measurements made using C^{6+}, N^{6+} and O^{6+} bombardment. (auth)

27003 USE OF BOUNDARY-CONDITION WAVEFUNCTIONS FOR BOUND STATES, CONTINUUM STATES, AND RESONANCES. Shore, B. W. (Univ. of California, Livermore). J. Phys., B (London); 7: No. 18, 2502-2517(21 Dec 1974).

Supplementing the Schroedinger equation with (artificial) boundary conditions in the traditional manner selects discrete scattering energies and alters bound-state wavefunctions. Two examples of single-channel scattering, electron-$He^+(1s)$ and neutral particle-soft shell, illustrate the dependence of phase shifts and bound states upon boundary condition. Comparison of nodal and antinodal boundary conditions tests the termination error of bound-state computations and locates the positions of scattering resonances. (auth)

27004 EVALUATION OF SOME INTEGRALS REQUIRED IN LOW-ENERGY ELECTRON OR POSITRON-ATOM SCAT-

TERING. Ho, Y. K.; Page, B. A. P. (Univ. of Western Ontario, London). J. Comput. Phys.; 17: No. 2, 122-131(Feb 1975).

Various integrals containing either long-range terms or trigonometric functions arise in low energy electron or positron-atom scattering problems. Analytical evaluation of such integrals becomes very difficult. Expressions are developed involving one final radial numerical integration, the other integrations being calculated analytically. These latter expressions may also be used in the optical potential method for scattering problems. The expressions are developed from expanding r_{ij}^{ν} in terms of Legendre polynomials. Using integrals for which analytical results are readily calculated for comparison purposes, it is found that at least ten significant figures are obtained from a 25-point Gauss–Laguerre quadrature. (auth)

27005 INTERACTION BETWEEN AN EXCITED ATOM AND SMALL-RADIUS ATOM. Kereselidze, T. M.; Chibisov, M. I. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 12-21(Jan 1975). (In Russian).

The interaction between an excited atom and a small-size potential well is considered. Expressions which are valid for arbitrary atoms are obtained for the asymptotic energy shifts of atomic and ion levels in the region of their quasi-intersection. It is shown that for the purely Coulomb case term splitting on quasi-intersection is, due to level degeneracy, approximately $\sqrt{m}$ times (m is the principal quantum number) greater than for an arbitrary atom of the same energy. It is also shown that the accuracy of all the asymptotic formulas is higher (for an expansion in inverse powers of the internuclear distance) than was previously considered. (auth)

27006 EXCITATION OF MULTICHARGED IONS BY ELECTRON IMPACT. Presnyakov, L. P.; Urnov, A. M. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 61-68(Jan 1975). (In Russian).

The set of strong coupling integral equations for the problem of excitation of ions with charges $Z \gg 1$ by electron impact is solved. The representation for the radial Green function for a Coulomb field employed permits one to obtain the solution in the form of a correct expansion in a small parameter Z^{-1}. The asymptotically exact expression for the scattering matrix contains two terms which describe potential and resonant scattering respectively. It is shown that coupling between open channels leads to small corrections in the parameter Z^{-1} to the potential scattering. In the cross section averaged over resonances the contribution of the resonance term corresponding to strong coupling with closed channels is of the same order of magnitude as the potential scattering and in some cases is decisive. For illustration, the results of numerical calculations of the excitation cross sections of a number of transitions in the lithium–like oxygen ion are presented. (auth)

27007 EXCITATION OF THE FINE-STRUCTURE LEVELS OF ATOMIC OXYGEN BY SLOW ELECTRONS. Tambe, B. R.; Henry, R. J. W. (Louisiana State Univ., Baton Rouge). Phys. Rev., A; 10: No. 6, 2087-2092(Dec 1974).

Calculations of cross sections for the excitation of fine-structure levels of the ground ^3P state of atomic oxygen by electron impact in the energy range of 500 to 15000°K are obtained by a close-coupling method. Below 3000°K, it is necessary to allow for energy differences between the fine structure levels. Above 3000°K, polarization effects were incorporated by use of pseudostates and are found to decrease the cross sections slightly. Collision strengths are a factor of 3 to 5 lower than those obtained by Breig and Lin. In view of recent multiconfiguration results of Saraph the single-configuration calculations probably represent a lower limit to the fine-structure collision strengths. (auth)

27008 ELECTRON CAPTURE BY PROTONS IN HELIUM AND HYDROGEN ATOMS AT INTERMEDIATE ENERGIES. Winter, T. G.; Lin, C. C. (Univ. of Wisconsin, Madison). Phys. Rev., A; 10: No. 6, 2141-2155(Dec 1974).

Cross sections for electron capture into each excited state of hydrogen up to 4f by proton impact on hydrogen and on helium in the energy range of 15 to 1000 keV were calculated by means of the Born approximation (Bate's version). In addition are used the method of close coupling to calculate the 2s, 3s, 2p, 3p, and 3d cross sections for the proton-helium process in the energy range of 30 to 300 keV. Evaluation of the two-center integrals occurring in the Born amplitude was facilitated by expanding the atomic wave functions in terms of Gaussian-type orbitals. At high energies the relative cross sections of the nl states (obtained from the Born approximation) for a given l may be related to the importance of close encounters. For the close-coupling calculations there were included as many as eleven states in the multistate expansion of the total wave function. The effects of the intermediate states on the cross sections of the various excited states were examined. The convergence of multistate cross sections to the two-state cross sections and to the Born cross sections is found to be slow, particularly for p and d states. Comparison of the 11-state close-coupling cross sections of the proton-helium process with experiment shows substantial agreement for the 2s and 2p states, and, at lower energies, for the 3s, 3p, and 3d states. At higher energies, however, differences between theory and experiment for the 3s, 3p, and 3d states somewhat exceed estimated experimental errors. (auth)

27009 NEW STATIONARY BOUNDS ON MATRIX ELEMENTS INCLUDING POSITRON–ATOM SCATTERING LENGTHS. Blau, R.; Rosenberg, L.; Spruch, L. (New York Univ.). Phys. Rev., A; 10: No. 6, 2246-2256(Dec 1974).

In a previous study of bound-state matrix elements of a Hermitian operator W, it was possible to obtain at most an upper (or lower) stationary bound. The possibility arose only for the diagonal matrix element case, and only for W nonpositive (or nonnegative). In the present treatment, both upper and lower stationary bounds are obtained, for diagonal and off-diagonal matrix elements, and, though some restrictions on W remain, the requirement that W be of well defined sign can be dropped. The derivation also improves upon that given previously in that the possibility of any difficulty with near singularities in the equation defining the trial auxiliary (or Lagrange) function is unambiguously avoided. As an example, the method is applied to the problem of the zero-energy scattering of positrons by atoms or ions, and an expression is derived which provides a rigorous stationary upper bound on the scattering length; the target ground-state wave function need not be known exactly. Crude but rigorous numerical results are obtained quite simply in the Born approximation. (auth)

27010 e^-–H SCATTERING FOR A WIDER RANGE OF ENERGY. Chaudhuri, J.; Ghosh, A. S.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Phys. Rev., A; 10: No. 6, 2257-2263(Dec 1974).

An integral form of the close-coupling approximation was applied to the scattering of electrons by hydrogen atoms with the retention of only the 1s state, the effect of exchange being included. Results for the differential and the total cross sections were obtained from 1 to 500 eV. The calculated results were compared with the experimental findings and other theoretical results and are found to be fairly reliable throughout the entire energy range. The present results differ from Born values by about 4% even at 500 eV. (auth)

Atomic Theory

Refer also to abstracts 26960 and 28903.

27011 RESIDUAL POTENTIAL METHOD. I. Two-Potential Calculation for S-Wave Phase Shift. Liew, Y. C.; Quah, L. C. (Univ. Sains Malaysia, Penang). J. Phys., B (London); 7: No. 18, 2495-2501(21 Dec 1974).

The original potential is separated into a square well potential and a weaker "residual potential". It is then found that the Born series converges faster to the exact value of the phase shift and the second Fredholm, [1, 1] Padé and Fredholm-Padé estimates for the phase shift are considerably improved. This is demonstrated by performing simple calculations of S-wave phase shift for exponential potentials, screened Coulomb potential and static potential of atomic hydrogen. (auth)

27012 MAGNETIC RELAXATION OF OPTICALLY ORIENTED NUCLEI OF ATOMS INTERACTING WITH A WALL. Putyrskii, V. P.; Izyumova, T. G. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 3, 227-230(Sep 1974).

Translated from Opt. Spektrosk; 37: No. 3, 399-406(Sep 1974).

A method is presented for theoretical calculation of the nuclear moment relaxation times of an atom adsorbed on the wall of a container. The temperature dependence of the relaxation time is obtained, and a comparison is made with the available experimental data. (auth)

27013 ASYMPTOTICALLY EXACT SOLUTION FOR THE GENERALIZED DICKE MODEL. Brankov, I. G.; Zagrebnov, V. A.; Tonchev, N. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 22: No. 1, 20-30(Jan 1975). (In Russian).

The exact solution for the generalized Dicke model is obtained by using a modification of the method of N. N. Bogoliubov, Jr. Thermodynamics of the boson and spin subsystems is studied. It is shown that the initial system containing interaction with a boson field is thermodynamically equivalent to an anisotropic X-Y-model with infinitely long range of interaction. (auth)

27014 METHOD FOR SOLVING THE QUASIPARTICLE EQUATION FOR ATOMS. Machil'skii, A. P. Zh. Eksp. Teor. Fiz.; 68: No. 1, 22-27(Jan 1975). (In Russian).

Relative coordinates forming connected manifolds are employed for describing the internal motion of multielectron atoms. Differential operations on connected manifolds are applied for determining the quasiparticle equation for atoms and an approximate analytic method for its solution is proposed. The method is tested by calculations of the ground and excited states of the helium atom and of the ground states of some two-electron ions. (auth)

27015 ATOMS IN MODERATELY STRONG ELECTROMAGNETIC FIELDS: GENERAL METHOD AND ITS APPLICATION TO THE TWO-LEVEL ATOM. Coulter, C. A. (Univ. of Alabama, University). Phys. Rev., A; 10: No. 6, 1946-1954(Dec 1974).

The desirability of considering "dressed" rather than "bare" states of atoms in strong electromagnetic fields has been noted by others. It is suggested that such a treatment is conveniently carried out by performing a unitary transformation of the Hamiltonian so that the "dressed" states in the new basis are precisely the "bare" states of the usual basis. A perturbative method for constructing such a transformation, closely related to a procedure described by Heitler, is proposed. The method is applied through second order to a two-level atom model, and it is verified that the transformation makes the dressed ground atomic state stable, and the excited state unstable with the proper decay probability; furthermore, the energies of the two states are renormalized by the correct amounts. The method is then compared with the "nonperturbative" momentum-translation approximation, and shown to contain already in first order the entire operator content of that approximation, but to yield different transition probabilities. Finally, the transformation method is applied through second order to the standard scalar-field model and shown to produce the usual dressing transformation, mass renormalization, and induced nucleon–nucleon potential of that model, a result which tends to substantiate the hypothesis that the transformation produces the correct dressed states of a physical system. (auth)

27016 VARIABLE-RADIUS EXCHANGE HOLE ASSOCIATED WITH ELECTRONS IN ATOMS AND IONS. Csavinszky, P. (Univ. of Maine, Orono). Phys. Rev., A; 10: No. 6, 2510-2511(Dec 1974).

The concept of exchange hole plays an important role in Slater's approximation to the Hartree–Fock equations. Use is made of analytical variational solutions of the Thomas–Fermi equation for neutral atoms and ions, and an expression is derived for the radius of the exchange hole that depends on the position of the electron considered. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

27017 NONSTATIONARY MAGNETOHYDRODYNAMIC FLOW AND WAVE PROPAGATION. Antimirov, M. Ya.; Boguslavskii, Yu. Ya. Sov. Phys.–Tech. Phys. 19: No. 7, 878–879 (Jan 1975).

It is well known that propagation of waves in an absorbing medium is accompanied by a unidirectional motion of this medium—a flow that arises because the wave loses momentum as well as energy. In accordance with momentum conservation these losses are compensated by the flow. The present paper considers a system of equations describing nonstationary flow in a conducting medium in a magnetic field. The nonstationary solutions obtained relax after a time to the steady state. It is shown that the transition to the steady state depends on the Hartmann number and that it can be oscillatory or monotonic. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 27145, 27147, and 27150.

27018 (CONF-720923-P4, pp 407-319) PRESENT POSITION AND FUTURE PROSPECTS FOR THE DISCOVERY OF NEW PARTICLES. Adair, R. K. (Yale Univ., New Haven). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 4.

The discussion of the present position and future prospects for the discovery of new particles includes quarks, magnetic monopoles, the intermediate vector boson, and heavy leptons. (JFP)

27019 (JINR-P13-8538) SETUP DESIGNED FOR SEARCH FOR NEW METASTABLE PARTICLES BY MEANS OF DETECTING THE DELAYED HIGH-ENERGY RADIATION. Alekseev, G. D.; Ganichev, V. I.; Kalinina, N. A.; Korolev, V. M.; Kruglov, V. V.; Kuznetsov, V. N.; Kulikov, A. V.; Kuptsov, A. V.; Nemenov, L. L.; Khazins, D. M.; Churin, I. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 18p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

An experimental setup is described designed for search for new long-lived particles at the Serpukhov accelerator. The decay products are detected by scintillation counters, filmless spark chambers and water Cherenkov spectrometer. The 16-dimensional amplitude analysis system is used as well as a number of standard and specially designed CAMAC modules. The work is performed using BESM-3M on-line computer. (auth)

27020 (SLAC-179(Vol.2), pp 205-221) RECENT RESULTS FROM SERPUKHOV. Morrison, D. R. O. (CERN, Geneva). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

An attempt is made to review recent results and current work at Serpukhov. Total cross sections, elastic scattering, the real part in π^-p elastic scattering, polarization in elastic scattering, π^-p charge exchange, $\pi^-p \rightarrow n$ + neutral meson, regeneration, bubble chambers, other experiments, and future accelerators are discussed. (JFP)

27021 (SLAC-179(Vol.2), pp 279-297) PROCESSES AT LARGE TRANSVERSE MOMENTUM. Cronin, J. W. (Univ. of Chicago). Nov 1974.

From SLAC summer institute on particles physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

A lecture is given reviewing the experimental results available on processes involving the production of particles at large transverse momentum. The lecture will be divided into three parts: single particle inclusive spectra at 90° c.m.; implications of direct muon production on the production of high transverse momentum vector mesons; and processes correlated with high transverse particle production. (auth)

27022 PSI STORY. Walgate, R. New Sci.; 64: No. 928, 870-872(19 Dec 1974).

Experiments which led to the simultaneous discovery by Ting at Brookhaven and Richter at SPEAR of two new heavy particles provisionally named ψs, are described. Consideration is given as to where these particles fit into theory. Either they herald a unification of all elementary particles and the weak, electromagnetic and strong interactions or they are the tear that will begin a thorough unravelling of years of painstaking theoretical work. Suggestions that the ψ could be the neutral intermediate vector boson, a meson with one charm and one anticharm quark, or a D^{*0} charmed meson with one charm quark, or a colored particle or a heavy proton, are all considered. (UK)

27023 INCLUSIVE DISTRIBUTIONS AT SERPUKHOV ENERGIES. Pauli, E. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 1, 369-372(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Recent data on inclusive interactions at high energy are presented. (France)

27024 EXPERIMENTAL REVIEW OF HIGH MULTIPLICITY REACTIONS. Foa, L. (Scuola Normale Superiore, Pisa, Italy). J. Phys. (Paris), Colloq.; No. 1, 317-338(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The most relevant experimental information presented at the conference on high energy inclusive and semi-inclusive reactions is summarized. The aim of the present review is to identify possible asymptotic properties (as scale invariance) and to disentangle different production mechanisms, with particular emphasis on the diffractive component. A detailed discussion of new data on the two-body correlation function is given in order to provide a first insight in the dynamical features of multiparticle production. Finally, the most recent results and semi-empirical fits to the multiplicity distributions are presented. (France)

27025 BUBBLE CHAMBER WORK ON NON-DIFFRACTIVE QUASI-TWO-BODY REACTIONS. Otter, G. (Technische Hochschule, Aachen). J. Phys. (Paris), Colloq.; No. 1, 298-300(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

New results on the s- and t-dependences of some reactions are reviewed. (France)

Electromagnetic

Refer also to abstracts 27176 and 27522.

27026 (CONF-720923-P2, pp 29-55) ELECTRO AND PHOTOPRODUCTION RESULTS FROM DESY. Wolf, G. (DESY, Hamburg). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

A summary is given of data on electro- and photoproduction. These data are discussed in terms of the mass squared and laboratory energy of the virtual photon and the effective mass of the hadron system produced. Included are single-arm experiments, Δ and ρ electroproduction, and multiplicities and inclusive particle spectra in photo- and electroproduction. (JFP)

27027 (CONF-720923-P2, pp 83-97) INCLUSIVE ELECTROPRODUCTION OF HADRONS AT 19.5 GeV. Dakin, J. T.; Feldman, G. J.; Lakin, W. L.; Martin, F.; Perl, M. L.; Petraske, E. W.; Toner, W. T. (Stanford Linear Accelerator Center, CA). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

A report is given of inclusive measurements, in the forward direction, of the electroproduction of hadrons using a hydrogen target. The incident electron energy was 19.5 GeV. The various distributions, charge ratios, and cross sections are discussed. (JFP)

27028 (CONF-720923-P2, pp 98-105) DEEP INELASTIC ELECTRON SCATTERING FROM HYDROGEN AND DEUTERIUM. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

Some additional features of the large-angle data shown by further analysis are considered for inelastic electron–proton scattering at 18, 26, and 34°. The cross sections and proton and deuteron structure functions are discussed. Also information about the neutron was extracted. (JFP)

27029 (CONF-720923-P2, pp 336-339) SEARCH FOR MAGNETIC MONOPOLES AT THE 70-GeV IPHE PROTON SYNCHROTRON. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The result of a search for magnetic-charged particles at the 70-GeV IPHE proton accelerator is presented. Using the "ferromagnetic trap" method, the upper limit of the magnetic monopole production cross section in proton-nucleon collisions $\sigma(95\%) \leq 1.4\ 10^{-43}$ cm^2 was found. (auth)

27030 (CONF-720923-P2, pp 340-343) PRELIMINARY EXPERIMENTAL RESULTS ON A SEARCH FOR THE DIRAC MONOPOLE AT THE 70 GeV IHEP SYNCHROTRON USING VAVILOV–CHERENKOV RADIATION. 1972.

From 16 international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The pair production of monopole–antimonopole ($g,\bar{g}$) with masses up to 5.5 M_p and velocities above the emission threshold of Cherenkov radiation in a transparent medium with n = 1.5 is considered. Upper limits on magnetic monopole production cross sections by 70-GeV protons on SiO_2 targets were found. (JFP)

27031 (CONF-720923-P2, pp 371-374) SEARCH FOR TACHYON MONOPOLES. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

Tachyon monopoles were looked for in the lead shield of a 20,000 Ci ^{60}Co source. No tachyon monopoles were found. (JFP)

27032 (CONF-720923-P4, pp 41-117) ELECTROPRODUCTION AND DEEP INELASTIC SCATTERING: A LOOK AT THE FINAL STATES. Berkelman, K. (Cornell Univ., Ithaca, NY). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 4.

The review of electroproduction and deep inelastic scattering final states includes only those experiments in which one or several of the electroproduced hadrons is observed in coincidence with the scattered electron. Electron scattering and photoproduction results, definitions of electroproduction variables, coincidence electroproduction experiments, diffractive two-body electroproduction, inclusive virtual-photon reactions, multiplicity, two puzzles, and some speculations are discussed. (JFP)

27033 (DESY-75/01) PHOTOPRODUCTION OF π^+-MESONS ON POLARIZED PROTONS. Genzel, H.; Heide, P.; Knuetel, J.; Lierl, H.; Mess, K. H.; Schachter, M. J.; Schmueser, P.; Sonne, B.; Vogel, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jan 1975. 20p. Dep. NTIS (US Sales Only) $4.00.

The asymmetry of the cross sections for the photoproduction of π^+-mesons on polarized protons $\gamma + p\uparrow \rightarrow \pi^+ + n$ was studied in the four-momentum transfer range $0.1 \leq |t| \leq 1.25$ (GeV/c)^2 for photon energies of 2.5, 3.4 and 5.0 GeV. The measurements were carried out on a polarized butanol target. Both particles in the final state were detected: the pion by a magnetic spectrometer, the recoil nucleon in a scintillation counter matrix. The asymmetry was found to be negative with values around −0.4. (auth)

27034 ELECTROPRODUCTION OF π^0 AND π^+ MESONS IN THE $\Delta(1236)$ RESONANCE REGION. Beck, U. (Bonn Univ. (F.R. Germany). Mathematisch-Naturwissenschaftliche Fakultaet). 1973. 80p. (In German). INIS.

50 figs.; 13 tabs.; 35 refs.; with app. Available from the library of the Bonn Univ.

Charged hadrons (p,π^+) were measured in coincidence with scattered electrons of the 2.5-GeV Bonn Synchrotron. From the ($p\pi^0$) angular distribution there follows dominance of the magnetic dipole amplitude M_1^+. (GE)

27035 RELATIONS BETWEEN THE ELECTROEXCITATION OF NUCLEON RESONANCES AND THE DEEP INELASTIC CONTINUUM FOR PROTON AND DEUTERON TARGETS. Koebberling, M.; Moritz, J.; Schmidt, K. H.; Wegener, D.; Zeller, D. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik); Bleckwenn, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Heimlich, F. H. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Nucl. Phys., B; 85: No. 2, 365-374(27 Jan 1975).

New data of the electroexcitation cross section on protons and deuterons in the resonance region are compared with the results in the deep inelastic region for four-momentum transfers $q^2 \leq 1.5$ (GeV/c)^2. The Bloom-Filman sum rule is shown to hold for $q^2 \geq 1.2$ (GeV/c) while the Rittenberg-Rubinstein sum rule is saturated for $q^2 \geq 0.4$ (GeV/c)^2. It is shown that the sum rules do not saturate in a local way. (auth)

27036 A MEASUREMENT OF LARGE ANGLE e^+e^- SCATTERING AT THE 3100 MeV RESONANCE. Braunschweig, W.; Jordan, C. L.; Martyn, U.; Sander, H. G.; Schmitz, D.; Sturm, W.; Wallraff, W. (Technische Hochschule Aachen (F. R. Germany). 1. Physikalisches Inst.); Berkelman, K.; Cords, D.; Felst, R. Phys. Lett., B; 53: No. 4, 393-396(23 Dec 1974).

Elastic e^+e^- scattering has been measured at total energies covering the newly found resonance at 3100 MeV. The angular distribution is consistent with spin–parity 1^-, and the cross section integrated over energy yields $\Gamma_{ee}^2/\Gamma_{tot} = 0.23 \pm 0.05$ keV for the resonance. (auth)

27037 CROSS-SECTION MEASUREMENTS FOR THE EXCLUSIVE REACTION $e^+e^- \rightarrow 4\pi^\pm$ IN THE ENERGY RANGE 1.2–3.0 GeV. Bernardini, M.; Bollini, D.; Brunini, P. L.; Fiorentino, E.; Massam, T.; Monari, L.; Palmonari, F.; Rimondi, F.; Zichichi, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 53: No. 4, 384-386(23 Dec 1974).

The cross section for the reaction $e^+e^- \rightarrow 4\pi^\pm$ in the energy range 1.2–3.0 GeV has been measured. No statistically significant evidence for a new vector meson in the ρ'' region is found. (auth)

27038 e^+e^- REACTIONS–EXPERIMENTS. Larsen, R. R. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 395-408(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Current results of the SLAC-LBL survey experiment** on the annihilation of e^+e^- into hadrons in the s range 6 to 25 GeV^2 were presented. (auth)

27039 POLARIZED–PHOTON ASYMMETRIES IN K^+ PHOTOPRODUCTION AT 16 GeV. Quinn, D.J.; Rutherfoord, J.P.; Shupe, M.A. (Physics Department, Tufts University, Medford, Massachusetts 02155); Sherden, D.J.; Siemann, R.H.; Sinclair, C.K. Phys. Rev. Lett. 34: No. 9, 543-546 (3 Mar 1975).

Using a 16–GeV linearly polarized photon beam, we have measured asymmetries in the process $\gamma N \rightarrow K^+(\Lambda+\Sigma)$ from hydrogen and deuterium, for square of four–momentum transfer, t, between −0.01 and −0.8 (GeV/c)^2. The data show that, for $-t \gtrsim 0.1$ (GeV/c)^2, the cross sections for $\gamma p \rightarrow K^+\Lambda$, $\gamma p \rightarrow K^+\Sigma^0$, and $\gamma n \rightarrow K^+\Sigma^-$ are strongly dominated by natural–parity exchange, as is the case in single–pion photoproduction. (auth)

27040 EXPERIMENTAL RESULTS ON THE REACTION $e^+e^- \rightarrow$ PHOTONS AT THE 3.1 GeV RESONANCE. Bacci, C. (Univ., Rome); Penso, G.; Stella, B. Lett. Nuovo Cim.; 12: No. 8, 269-272(22 Feb 1975).

Some preliminary results of research on the channels $e^+e^- \rightarrow \pi^0\gamma$, $\eta\gamma(\eta \rightarrow 2\gamma)$ and $e^+e^- \rightarrow 2\gamma$ at 3.1 GeV are reported. Upper limits for the cross sections of the channels of the first reactions are obtained. And for the second reaction, the results thus far are not inconsistent with the quantum electrodynamics predictions. The position and shape of the 3.1 GeV resonance are also shown, and upper limits for the ratios of the partial decay rates of this resonance are found. (JFP)

Weak

Refer also to abstracts 27277, 27282, and 27296.

27041 (CONF-720923-P2, pp 66-82) HADRONIC FINAL STATES FROM INELASTIC MUON SCATTERING IN A HYBRID BUBBLE CHAMBER EXPERIMENT. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

A preliminary analysis is reported of a hybrid bubble chamber experiment in which the process $\mu^- + p \rightarrow \mu^- + X$, where X is detected with 4π geometry. Total and topological partial cross sections, multiplicities, ρ^0 and ω production, inclusive $\gamma_v + p \rightarrow p + X$, and $p_\perp^2$ distributions are discussed. (JFP)

27042 (CONF-720923-P2, pp 106-112) DEEP INELASTIC μ PAIR PHOTOPRODUCTION. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The photoproduction of μ pairs via the Compton diagram was studied in order to test some two-photon predictions of a parton model of deep inelastic electron scattering. The obtained cross sections are shown. A strong case is given for the conclusion that the observed rate is due to μ pairs produced in the target. (JFP)

27043 (CONF-720923-P2, pp 206-207) PRELIMINARY RESULT ON THE RATIO OF ANTINEUTRINO TO NEUTRINO TOTAL CROSS SECTIONS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The preliminary results of the CERN 1971 neutrino experiment are presented for cross sections and the ratio of antineutrino to neutrino total cross sections $R = \sigma(\bar{\nu})/\sigma(\nu)$. (JFP)

27044 (CONF-720923-P2, pp 321-327) SEARCH FOR HEAVY QUASI-STABLE LEPTONS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

A search was made for heavy charged quasi-stable leptons in the mass range from 1 to 5 GeV. These leptons could be produced in virtual electromagnetic processes when 70-GeV primary protons strike the internal aluminium target of the accelerator. Upper bounds for the differential and total cross sections for heavy lepton production were obtained, and upper bounds were established for the heavy lepton lifetime. (JFP)

27045 (CONF-720923-P2, pp 328-335) MUON PRODUCTION IN NN INTERACTIONS AT 70 GeV. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

A search was made for muons arising in the decay of hypothetic intermediate W bosons produced in nucleon–nucleon collisions. The typical results of measurements for decay curves and energy spectra for muons are presented. It is found that in the whole energy range under investigation there is observed a muon $X^{\pm}$ (E) component, not related to pion and kaon decay, and its intensity corresponds to a differential cross section for production on a nucleon of the order of magnitude 10^{-32} to 10^{-36} cm^2/sr at muon energies from 12 to 24 GeV. It is concluded that this component seems to be connected mainly with the electromagnetic production of muonic pairs. Upper limits on the cross section for W production were obtained for the mass interval from 3 to 10 GeV/c. (JFP)

27046 (CONF-720923-P2, pp 358-370) OBSERVATION OF MUONS AT LARGE ANGLES FROM CERN ISR. Birge, R.; Cence, R. J.; Duff, B. G. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

A search which is being carried out for muons with large transverse momenta produced in colliding beam interactions at the ISR is described. The momentum spectra and differential cross sections are discussed. (JFP)

27047 NEUTRINO INTERACTIONS. Musset, P. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 23-42(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The results obtained in the Argonne 12-foot H_2/D_2 bubble chamber, the 4.8m heavy liquid chamber Gargamelle at CERN, and in two large electronic apparatus at NAL, one placed in a wide-band energy beam, and the other in a narrow-band energy beam, relate mainly with the following topics: a more detailed study of elastic and quasi-elastic (Δ) reactions at Argonne; a precise study of muonic neutrino and muonic antineutrino cross sections on nucleons in Gargamelle; first observation of high energy neutrinos reactions in the 20 to 100 GeV range, and measurements on the neutrinos and antineutrinos cross sections, in the NB and WB experiments; first measurements of electronic neutrino and electronic antineutrino cross sections on nucleons in the Gargamelle experiment; improved limits at NAL in the WB beam and NB beam on the mass of the W boson and limits on the mass of the possible heavy leptons in the NB beam and in the Gargamelle experiment; observation of muonless events which behave as expected from neutral currents induced processes, in the Gargamelle experiment. A very new result on the same type of events in the WB NAL experiment was also presented at the Bonn conference. (France)

27048 NEUTRINO INTERACTIONS IN THE RESONANCE REGION. Musgrave, B. (Argonne National Lab., IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 22-51(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A review of results on charged current ν-nucleon interactions from the Argonne–Purdue experiment is presented. (auth)

27049 EXPERIMENTAL STATUS OF HYPERON BETA DECAY. Winston, R. (Univ. of Chicago). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 52-61(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A number of high statistics experimental results on hyperon beta decay have recently become available. These include a study of unpolarized Σ decays from the AGS hyperon beam, a bubble chamber study of unpolarized Λ decay and two optical spark chamber experiments on polarized Λ decays. The experimental situation is reviewed in the context of the Cabibbo SU(3) scheme, and prospects for new information from experiments now under way will be discussed. (auth)

27050 SECOND CLASS CURRENTS–RECENT EXPERIMENTS. Freedman, S. J. (Princeton Univ., NJ). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 62-74(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Experimental tests for second class axial-vector currents in strangeness conserving semileptonic weak interactions are briefly reviewed. The ft-asymmetry comparisons of Wilkinson and two correlation studies now in progress by Princeton groups are discussed. The question of the existence of second class currents is considered to be experimentally unresolved at present. (auth)

27051 RECENT EXPERIMENTAL RESULTS ON CP VIOLATION. Carithers, W. C. Jr. (Univ. of Rochester, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 75-83(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

The review on experimental results on CP violation concentrates heavily on recent results of programs using a PWC spectrometer using the vacuum regeneration technique and a comparable apparatus using the regenerator technique. The K_S decay rate, the $K_L - K_S$ mass difference, the phase of $\eta_{\pm}$, $\phi_{\pm}$, and a comparison with superweak interactions are discussed. (JFP)

27052 LEPTONS AND HADRONS AT HIGH TRANSVERSE MOMENTA. Bourquin, M. (Columbia Univ., New York). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 287-300(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

The evidence for direct lepton production at high energy and large transverse momentum is reviewed. The yields are much higher than predicted by current models. Comparison is made with hadron production at large transverse momenta. (auth)

27053 NEUTRAL CURRENTS IN HIGH–ENERGY NEUTRINO COLLISIONS: AN EXPERIMENTAL SEARCH. Barish, B.C.; Bartlett, J.F.; Brown, K.W.; Buchholz, D.; Jacquet, F.; Merritt, F.S.; Sciulli, F.J.; Suter, H. (California Institute of Technology, Pasadena, California 91125); Fisk, H.E.; Krafczyk, G. Phys. Rev. Lett 34: No. 9, 538-541 (3 Mar 1975).

A search for events with no final–state muon, as expected in the neutral–current interactions $\nu_\mu(\bar{\nu}_\mu) + N \rightarrow \nu_\mu(\bar{\nu}_\mu) +$ hadrons, has been carried out by using the California Institute of Technology–Fermilab neutrino detector and narrow–band neutrino beam. A clear signal of events with no apparent final–state muon has been observed. Furthermore, missing energy in the final state for these events provides strong evidence for the existence of a final–state ν. (auth)

27054 OBSERVATION OF NEW–PARTICLE PRODUCTION BY HIGH–ENERGY NEUTRINOS AND ANTINEUTRINOS. Benvenuti, A.; Cline, D.; Ford, W.T.; Imlay, R.; Ling, T.Y.; Mann, A.K.; Messing, F.; Orr, R.; Reeder, D.D.; Rubbia, C.; Stefanski, R.; Sulak, L.; Wanderer, P. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 34: No. 7, 419-422 (17 Feb 1975).

We have observed fourteen events in which two muons are produced by high–energy neutrino and antineutrino interactions. The absence of trimuon events and the observed characteristics of the dimuon events require the existence of one or more new massive particles that decay through the weak interaction. The new particle mass is estimated to lie between 2 and 4 GeV. (auth)

Strong (Baryon-induced)

Refer also to abstracts 27117, 27119, 27133, 27316, 27318, 27326, 27337, 27385, and 27552.

27055 (CONF-720923-P1, pp 211-223) CHARGED PARTICLE PRODUCTION AT THE ISR. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

In this summary an attempt is made to unify the experimental data at the ISR and to show the gross features they reveal. Charged particle production, various distributions, cross sections, spectra, and multiplicities are discussed. (JFP)

27056 (CONF-720923-P1, pp 224-237) HIGH ENERGY PP CHARGED PARTICLE MULTIPLICITY PARAMETERS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

A review is presented on multiplicity parameters from high energy pp collisions. Also some of the new results from the analysis of individual topologies and events from the 205-GeV/c bubble chamber data are reported. The topological cross sections for high energy pp interactions are discussed. (JFP)

27057 (CONF-720923-P1, pp 240-243) EVIDENCE FOR TWO COMPONENTS IN HIGH ENERGY PP COLLISIONS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

Recent hydrogen bubble chamber experiments have yielded relatively high accuracy charged particle multiplicity distributions. The shape of these distributions is explained by fitting the data as the sum of two Poisson distributions for the number of negative particles (and consequently the sum of two noninteracting separate ideal gases). It is concluded that at higher energies the multiplicity distributions do not follow a Poisson distribution as they appear to do at moderate energies. The shape of the distribution at 400 GeV/c is obtained. (JFP)

27058 (CONF-720923-P1, pp 244-251) NEUTRAL PION PRODUCTION AT ISR AND NAL. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

Bubble chamber experiments on cross sections for $pp \rightarrow \gamma +$ anything at $\sqrt{s} = 20$ GeV and $pp \rightarrow T + \gamma +$ anything, $pp \rightarrow T + 2\gamma +$ anything, and $pp \rightarrow T + \gamma + n_{charged}$ + anything at $\sqrt{s} = 23$ to 53 GeV presented previously are discussed regarding new results from $\gamma\gamma$ correlations. The correlations found between photons and the charged particles in a cone are shown. (JFP)

27059 (CONF-720923-P3, pp 219-320) STRONG INTERACTIONS AT HIGH ENERGIES. Giacomelli, G. (Univ., Padua). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 3.

New experimental results in strong interactions above 10 GeV are discussed. The general layout of the experiments at the three highest energy accelerators, topics of increasing experimental and theoretical complexity, total cross sections, elastic and charge-exchange scattering, other two-body and quasi-two-body processes, and some features of inelastic reactions are covered. (JFP)

27060 (CONF-720923-P3, pp 321-372) DIFFRACTION DISSOCIATION. Leith, D. W. G. S. (Stanford Linear Accelerator Center, CA). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 3.

The data on diffraction dissociation are summarized in a coherent picture by comparing the properties of these inelastic diffractive processes to those of elastic scattering. Data on cross sections, differential cross sections, and spin structure are considered. (JFP)

27061 (COO-3065-104) PRODUCTION OF $\Delta(1236)$ IN pp COLLISIONS AT HIGH ENERGIES. DeBrion, J. P.; Bromberg, C.; Ferbel, T.; Jensen, T.; Schindler, R.; Slattery, P.; Seidl, A. A.; Vander Velde, J. C. (Rochester Univ., N. Y. (USA); Michigan Univ., Ann Arbor (USA)). 3 Jan 1975. Contract AT (11-1)-3065. 5p. (UR-511; UMBC-74-19). Dep. NTIS $4.00.

Based on data obtained from exposures of the Fermilab 30-inch bubble chamber, a comparative study of inclusive Δ^{++} (1236) production in pp collisions at 102 and 400 GeV/c is presented. It is observed that, to better than 10% accuracy, the invariant cross section for Δ^{++} (1236) production for $|t| < 0.6$ GeV^2 and $|x| > 0.7$ does not depend on energy. A comparison of the observed properties of the neutral baryon system produced in association with the Δ^{++} (1236) and the known characteristics of π^-p collisions reveals a remarkable similarity between the properties of these two neutral multiparticle systems. (auth)

27062 (JINR-P-1-7522) SINGLE-VALUED PHASE SHIFT ANALYSIS OF PP-SCATTERING AT 630 MEV. Zul'karneev, R. Ya.; Murtazaev, Kh.; Satarov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 15p. (In Russian). INIS.

With the use of the latest experimental data of differential cross sections of elastic pp-scattering at small angles the phase shifts of pp-scattering at energies of 630 MeV are determined more accurately. A well-defined set of phase shifts at this energy is obtained. (tr-SJR)

27063 (NP-20294-P1, pp vp Paper 2) EMPIRICAL PROPERTIES OF SIMPLE INCLUSIVE SPECTRA. Petersson, B. (Univ., Geneva). 1973. (In French).

In summer school on particle physics, Gif-sur-Yvette, France, 24 September–6 October 1973. Volume I.

Accessible inclusive data are listed. One-particle spectra are studied: mean multiplicity, transverse momentum, fragmentation region, central region. (FR)

27064 (NP-20294-P1, pp vp Paper 3) MULTIPARTICLE PRODUCTION PROCESSES AT HIGH ENERGY. Berger, E. L. (CERN, Geneva). 1973.

In summer school on particle physics, Gif-sur-Yvette, France, 24 September–6 October 1973. Volume I.

After a brief survey of kinematics, notation and sum rules, empirical regularities of multihadron production whose validity is confirmed and extended by measurements at NAL and the ISR are cataloged. A list of new observations which must be incorporated into an over-all phenomenological scheme is given. Then the concept of dominant short-range order as an asymptotic unifying theme is discussed. The implications of this hypothesis for single particle inclusive spectra are compared with available data. Two phenomenological models are described: the Amati-Bertocchi-Fubini-Stranghellini-Tonin model and the fragmentation model. It is shown that from the inclusive approach, two-particle spectra can discriminate between these models. Evidence for long-range correlations is also present in ISR and NAL data. Single inelastic diffraction is studied and theoretical interpretation is given. Proton-proton interactions are considered in these lectures. (FR)

27065 (SLAC-179(Vol. 1), pp 289-305) RESONANCES: EXPERIMENTAL REVIEW. Cashmore, R. J. (Oxford Univ.). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume I.

Lectures are given on the experimental measurements and methods used to identify resonances and give their parameters. The properties such as mass, width, couplings etc. and the order of these resonances are considered. Meson–baryon and meson–meson interactions are discussed. (JFP)

27066 (SLAC-179(Vol. 2), pp 77-83) POLARIZED BEAM EXPERIMENTS AT THE ZGS. Krisch, A. D. (Univ. of Michigan, Ann Arbor). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

Elastic pp scattering at 6 GeV/c was studied in all four possible spin states with spins perpendicular to the scattering plane. The ratio of the cross section in each spin state to the spin average cross sections was plotted. And also the asymmetry parameter or polarization and a quantity which parametrized the difference between the parallel and antiparallel cross sections were plotted. The differential cross sections are plotted showing the relation between the change in the spin dependence and the break in the cross sections. From this plot is appears possible that the different regions seen in pp elastic scattering may be primarily associated with different spin states. (JFP)

27067 (SLAC-179(Vol. 2), pp 159-174) PROTON–PROTON INELASTIC SCATTERING AT FNAL. Franzini, P. (Columbia Univ., New York). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

Proton–proton inclusive interactions were studied over the energy range from 100 to 400 GeV, and comments were made on a previous study of p + p inelastic scattering from the p + d interaction. The cross sections are discussed. (JFP)

27068 (SLAC-179(Vol. 2), pp 223-235) TOTAL INELASTIC CROSS SECTIONS FOR $\pi^{\pm}$p, $K^{\pm}$p, AND $p^{\pm}$p INTERACTIONS. Morrison, D. R. O. (CERN, Geneva). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

The total inelastic cross sections σ_{inel} for the interactions $\pi^{\pm}$p, $K^{\pm}$p and $p^{\pm}$p are derived. Reasons are given for preferring to use σ_{inel} rather than σ_T in studying the asymptotic behavior of cross sections. Both σ_{inel} (K^+p) and σ_{inel} (pp) rise monotonically with energy, the rise being faster for K^+p interactions. For $\pi^{\pm}$p, π^-p, K^-p and $\bar{p}p$ interactions, σ_{inel} decreases above 2 GeV/c then flattens out. A minimum is observed in σ_{inel} (π^+p) near 20 GeV/c but at much higher energies in σ_{inel} (π^-p). These differences are attributed to the "threshold effect" of direct formation of resonances. The K^+p and pp systems being exotic are the most useful to study. The contributions of diffractive effects to inelastic and elastic processes are discussed. Another "threshold effect" is Reggeon exchange contributions to elastic scattering, which for pp scattering are found to fall as s^1. (auth)

27069 (SLAC-179(Vol. 2), pp 299-339) RECENT EXPERIMENTAL RESULTS FROM THE CERN–ISR. Giacomelli, G. (Univ., Padua). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

The review of experimental results from the CERN ISR covers total cross sections, elastic scattering, single-particle inclusive reactions, correlations, diffraction processes, exclusive reactions, processes at large transverse momentum, and particle searches. (JFP)

27070 MEASUREMENT OF INCLUSIVE NEUTRON SPECTRA AT THE ISR. Engler, J.; Gibbard, B.; Isenbeck, W.; Moennig, F.; Moritz, J.; Pack, K.; Schmidt, K. H.; Wegener, D. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik); Bartel, W.; Flauger, W. Nucl. Phys., B; 84: No. 1, 70-82(6 Jan 1975).

With a total absorption counter, inclusive neutron spectra p + p → n + anything were measured at four ISR energies and at angles of 20, 66 and 119 mrad. The spectra show scaling behavior in the variables x and $p_\perp$. Pion exchange is found to be important at large x values. (auth)

27071 PARTICLE RATIOS IN THE CENTRAL REGION OF HIGH-ENERGY PROTON-PROTON COLLISIONS. Fredriksson, S. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Teoretisk Fysik). Nucl. Phys., B; 84: No. 1, 234-252(6 Jan 1975).

Recent data from NAL on particle ratios K^-/π^- and p^-/π^- at large transverse momentum are analyzed with emphasis on the surprising discovery that pions increase their dominance over heavier hadrons at increasing transverse momentum. It is argued that this is not a phase space or threshold effect but a dynamical feature that can be used to test theoretical models of multiparticle production. Most models of interest, such as for instance the parton, the hydrodynamical and the two-component model, may however be extended, in a simple-minded way, to kaon and antiproton production as to predict ratios of heavier to lighter hadrons to fall with increasing large transverse momentum. (auth)

27072 NEUTRON-PROTON CHARGE-EXCHANGE SCATTERING FROM 8 TO 29 GeV/c. Kreisler, M. N.; Davis, M. B. (Princeton Univ., N. J. (USA)); Longo, M. J.; O'Brien, D. D. (Michigan Univ., Ann Arbor (USA)). Nucl. Phys., B; 84: No. 1, 3-54(6 Jan 1975).

The differential cross sections for neutron-proton charge-exchange scattering were measured for incident neutron momenta between 8 and 29 GeV/c and for four-momentum transfers $|t|$ between 0.002 and 1.0 $(GeV/c)^2$. A neutron beam with a broad momentum spectrum was scattered from a liquid hydrogen target. The momenta and scattering angles of the forward-scattered protons were measured by a spark-chamber magnet spectrometer. The flight times and scattering angles of the recoil neutrons were measured by a bank of thick scintillation counters. The efficiencies of the neutron counters were determined in a separate measurement. Absolute normalization of the data was obtained from a measurement of the diffraction dissociation of neutrons from carbon nuclei. Differential cross sections, based on ~23,000 events, are presented for 9 different momenta. The shape of the differential cross sections and the momentum dependence are examined in detail. (auth)

27073 OBSERVATION OF INCREASING CHARGED MULTIPLICITY AS A FUNCTION OF TRANSVERSE MOMENTUM IN 28.5 GeV/c pp INTERACTIONS. Schuebelin, P. (Brookhaven National Lab., Upton, NY). J. Phys. (Paris), Colloq.; No. 1, 401-403(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The dependence of the mean charged multiplicity on the transverse momentum of the forward proton in the reaction p + p → p + MM for five intervals of missing mass MM is reported. Momenta between 10 and 28.5 GeV/c were covered. (France)

27074 POLARIZED TARGET RESULTS. Beusch, W. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 296-297(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

It is shown that considerable progress has been made in experiments with polarized targets. Measurements have been extended to 40 GeV/c and to K^-, nucleon and anti-nucleon charge exchange interactions. (France)

27075 NUCLEAR MULTIPLE PRODUCTION AT NAL ENERGIES AND BEYOND. Gottfried, K. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 363-364(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

It is shown that nuclear multiple production is astonishingly simple. A superficial glance at the nuclear data would not distinguish it from hydrogen: multiplicities in nuclei (per nuclear interaction—not per nucleon) differ but little from hydrogen, and the inclusive pion distribution in hydrogen and complex nuclei are indistinguishable for at least half of the full rapidity range. These facts were clearly established in a 200-GeV/c emulsion exposure at NAL. (France)

27076 PRELIMINARY OBSERVATION OF HIGH TRANSVERSE MOMENTUM PARTICLE PRODUCTION AT NAL. Cronin, J. W. (Univ. of Chicago). J. Phys. (Paris), Colloq.; No. 1, 418-420(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The yields of particles produced at NAL as a function of transverse momentum in proton-nucleus collisions were measured. Preliminary results from a tungsten target bombarded by 200 and 300 GeV protons are reported. (France)

27077 PRODUCTION OF LARGE TRANSVERSE MOMENTUM GAMMA RAYS IN pp COLLISIONS FROM 50 TO 400 GeV. Theriot, D. (National Accelerator Lab., Batavia, IL). J. Phys. (Paris), Colloq.; No. 1, 414-417(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

This experiment was performed using an internal target in the CO straight section of the National Accelerator. Data were taken over the complete range of proton energy available during the acceleration cycle. The results show that the single particle inclusive distribution deviates markedly from a simple exponential behavior. The energy dependence of this deviation between 50 and 400 GeV is presented. (France)

27078 $S \leq 1$ BARYON SPECTROSCOPY. Litchfield, P. J. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 227-232(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

New data about $S \leq -2$ and $S = -1$ baryon resonances are presented, together with partial wave analyses of the experiments involved. (France)

27079 HADRON SPECTROSCOPY. Butterworth, I. (Imperial Coll. of Science and Tech., London). J. Phys. (Paris), Colloq.; No. 1, 173-210(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The main sources of information for S = 0 baryon spectroscopy (πN elastic partial wave analysis and photoproduction experiments) are reviewed. Then the actual state of hyperon resonance data analysis and progress in meson experiment analysis are presented. (France)

27080 EXPERIMENTAL PROGRAM AT NAL. Jackson, J. D. (National Accelerator Lab., Batavia, IL). J. Phys. (Paris), Colloq.; No. 1, 429-444(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The major results of the NAL experimental program so far are: experiments on elastic scattering and inclusive proton and photon distributions from the gas jet target located at the internal target area, experiments with protons and positive and negative pions in the 30 inch hydrogen bubble chamber, and two neutrino experiments. (France)

27081 PRELIMINARY RESULTS ON CHARGED PARTICLE PRODUCTION AT HIGH TRANSVERSE MOMENTA IN p-p COLLISIONS AT 90 DEG AT THE CERN-ISR. Caroll, I. J. (Univ. of Liverpool). J. Phys. (Paris), Colloq.; No. 1, 407-408 (1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The preliminary data presented were obtained with a spectrometer at 90 deg to the proton beams at the CERN-ISR. Particle momenta were measured using a bending magnet and magnetostrictive spark chambers. Two threshold gas Cerenkov counters were used to separate pions, kaons and protons or antiprotons. A range of laboratory momenta from 1.6 to 5.2 GeV/c was covered with five different combinations of gas pressures and magnetic fields. (France)

27082 CHARGE-EXCHANGE RESULTS FROM SERPUKHOV. Kutin, V. M. (State Committee for Utilization of Atomic Energy, Serpukhov, USSR). J. Phys. (Paris), Colloq.; No. 1, 290-291 (1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Differential cross sections are given for the following reactions: pi minus + proton → pi zero + neutron; pi minus + proton → eta-zero + neutron; K-minus + proton → anti-K zero + neutron; antiproton + proton → antineutron + neutron. (France)

27083 AN ANALYSIS OF THE Λ(1520) OBSERVED IN A K^- NEUTRON PRODUCTION EXPERIMENT. Corden, M. J.; Cox, G. F.; Dartnell, A.; Kenyon, I. R.; O'Neale, S. W.; Sumorok, K. C. T. O.; Watkins, P. M. (Birmingham Univ. (UK). Dept. of Physics). Nucl. Phys., B; 84: No. 2, 306-322(13 Jan 1975).

The mass, width and branching fractions of the Λ(1520) into $\bar{K}N$, $\Sigma\pi$, $\Lambda\pi\pi$ and $\Sigma\pi\pi$ were determined using a Λ(1520) sample produced in the reaction $K^- d \rightarrow \Lambda(1520)\pi^- p_s$ at K^--neutron centre-of-mass energies between 1.9 and 2.2 GeV. A Dalitz plot analysis of the $\Lambda^0\pi^+\pi^-$ decay mode shows that there is a substantial $\Sigma(1385)\pi$ component. The SU(3) octet-singlet mixing angle for the $3/2^-$ baryons calculated from the partial widths for the s-wave $\Sigma(1385)\pi$ decay of the Λ(1520) and Λ(1690) is found to be consistent with that obtained from the d-wave decays of the singlet and octet members, within experimental limits. (auth)

27084 EXPERIMENTAL STUDY OF THE ENERGY DEPENDENCE IN PROTON-PROTON INCLUSIVE REACTIONS. Rossi, A. M.; Vannini, G. (Bologna Univ. (Italy). Istituto di Fisica); Bussiere, A. (European Organization for Nuclear Research, Geneva (Switzerland)); Albini, E.; D'Alessandro, D.; Giacomelli, G. (Padua Univ. (Italy). Istituto di Fisica). Nucl. Phys., B; 84: No. 2, 269-305(13 Jan 1975).

The energy dependence of the invariant cross section in pp inclusive reactions was studied for several fixed values of (p_t, x) and of (p_t, y_{lab}), where p_t, x, and y_{lab} are the transverse momentum, the Feynman variable, and the rapidity variable, respectively. The average transverse momentum and the multiplicities of each produced particle were computed as a function of energy. The results are compared with the predictions of some phenomenological models. (auth)

27085 NEGATIVE RESULTS OF A SEARCH FOR ALIGNMENT IN HIGH ENERGY COLLISIONS. Glasser, R. G. (Maryland Univ., College Park (USA)); Dao, F. T.; Hanft, R.; Lach, J.; Malamud, E.; Nezrick, F.; Voyvodic, L.; Whitmore, J. (National Accelerator Lab., Batavia, Ill. (USA)); Hyman, L.; Singer, R. (Argonne National Lab., Ill. (USA)). Phys. Lett., B; 53: No. 4, 387-389(23 Dec 1974).

Using proton-proton interactions at 205 and 300 GeV/c, a search for an alignment of the produced particles due to high angular momentum in the primary collision has been performed. The negative results of this search are discussed. (auth)

27086 ANALYSIS OF ANTI pp → $K^+K^-\pi^+\pi^-$ AROUND 1 GeV/c. Price, L. R.; Burns, R. R.; Condon, P. E.; Mandelkern, M.; Schultz, J. (California Univ., Irvine (USA). Dept. of Physics). Nucl. Phys., B; 85: No. 2, 326-336(27 Jan 1975).

Approximately 100,000 four-prong antiproton annihilations in hydrogen were measured. A clean, unbiased sample of 842 $K^+K^-\pi^+\pi^-$ events was obtained. This reaction is dominated by K^* (~45%) and ρ^0(~20%) production, with smaller amounts of A_2^0 (~15%) and ϕ(~5%) production. 25% of the reactions involve double resonance production. No significant three-body resonance production is observed. (auth)

27087 FIVE-PION FINAL STATE IN pp ANNIHILATIONS AT 0.7 TO 1.1 GeV/c. Burns, R. R.; Condon, P. E.; Donahue, J.; Mandelkern, M. A.; Price, L. R.; Schultz, J. (California Univ., Irvine (USA). Dept. of Physics). Nucl. Phys., B; 85: No. 2, 337-353(27 Jan 1975).

Results are reported on the reaction $\bar{p}p \rightarrow \pi^+\pi^+\pi^-\pi^-\pi^0$ at six lab momenta spanning the region from 0.686 to 1.098 GeV/c. The cross section for this process drops from 20.3 ± 1.2 mb at 0.686 GeV/c to 13.6 ± 1.0 mb at 1.098 GeV/c. Resonance production is determined by means of a model which includes Bose symmetrization, Breit-Wigner amplitudes and Bose-Einstein correlations for the like-charged pion pairs in the nonresonant part of the amplitude. The likelihood fit to the resonance channels yields about 0.8% $\eta\pi\pi$, 12% $\rho \pm \pi\pi$, 2% $f\pi\pi$, 8% $\omega\pi\pi$, 22% $\rho \pm \rho^0\pi$, 13% $\omega\rho^0$ and 9% ωf with errors on the order of a few per cent. Several percent $A_1^+\pi\pi$ and $X(1440)\pi$ were also needed to obtain good fits. The $\rho^0\pi\pi\pi$ and $\rho^0\rho^0\pi$ channels as well as $A_2\pi\pi$ and $A_2^0\pi\pi$ are consistent with zero. Reasonable fits to the mass distributions are obtained. Production angular distributions are found to be essentially uniform. The angular correlations between pion pairs are approximately fit by the simple model of resonance production with Bose symmetrization. (auth)

27088 MOMENTUM DEPENDENCE MEASUREMENTS OF THE np → pn CHARGE-EXCHANGE PEAK BETWEEN 1 AND 2 GeV/c. Bizard, G.; Bonthonneau, F.; Laville, J. L.; Lefebvres, F.; Malherbe, J. C.; Regimbart, R. (Caen Univ., 14 (France). Lab. de Physique Corpusculaire); Duflo, J.; Plouin, F. (Equipe Associee du C. N. R. S. No. 54 (France). Nucl. Phys., B; 85: No. 1, 14-30(20 Jan 1975).

21 differential cross section measurements of the np → pn charge-exchange reaction have been carried out at the synchrotron Saturne (Saclay), for incident neutron momenta between 1 and 2 GeV/c and in the squared four-momentum transfer range $0 \leq -t \leq 0.4$ $(GeV/c)^2$. The π exchange peak is seen at all the incident momenta. The s dependence of the very forward slope of this peak shows weak structures near the threshold of inelastic channels. (auth)

27089 EXPERIMENTAL TEST OF CHARGE SYMMETRY IN STRONG INTERACTIONS THROUGH THE REACTION: d + d → $^4He + \pi^0$. Banaigs, J.; Berger, J.; Goldzahl, L.; Vu-Hai, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. du Synchrotron Saturne); Cottereau, M.; Le Brun, C. (Caen Univ., 14 (France). Lab. de Physique Corpusculaire); Fabbri, F. L.; Picozza, P. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Phys. Lett., B; 53: No. 4, 390-392(23 Dec 1974).

The reaction d + d → $^4He + \pi^0$, forbidden by isotopic spin conservation, has been studied using 1.89-GeV/c incident deuterons. The upper limit of the differential cross section $(d\sigma/d\Omega)_{c.m.}$ obtained for this reaction at $\theta_{c.m.} = 79°$ is 1.9×10^{-35} cm^2/sr. (auth)

27090 HIGHLIGHTS OF RECENT STRONG INTERACTION EXPERIMENTS AT FERMILAB. Cool, R. L. (Rockefeller Univ., New York). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 158-198 (1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A review of selected results from recent experiments on strong interactions at the FERMILAB is given. (auth)

27091 RECENT RESULTS ON INCLUSIVE REACTIONS. Dao, F. T. (Fermi National Accelerator Lab., Batavia, IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 199-234(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Data concerning charged particle multiplicities, correlations between particles and single-particle inclusive distributions produced in high energy collisions are reviewed. (auth)

27092 TOTAL AND ELASTIC CROSS-SECTIONS AT HIGH ENERGY. Loveless, R. L. (Univ. of Michigan, Ann Arbor). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 235-262(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Total and elastic cross sections at high energy are summarized.

Emphasis is placed on the energy dependence and interrelations between various cross sections, the elastic results especially the slope near $t \sim 0.2(GeV/c)^2$ and its energy dependence, and the pp cross section near the observed dip at $t \sim 1.4(GeV/c)^2$. (JFP)

27093 HIGH ENERGY HEAVY ION COLLISIONS—A POSSIBLE TESTING GROUND FOR HIGH ENERGY INTERACTION MODELS. Schroeder, L. S. (Univ. of California, Berkeley). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 301-313(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A review of existing data on nucleus–nucleus collisions at Bevatron–Bevalac energies (few GeV/nucleon) is given to test to what extent such collisions can be compared to nucleon–nucleon studies performed at NAL and ISR energies. Data are examined for such phenomena as limiting fragmentation, scaling and factorization of cross sections. A brief discussion of experiments—either in progress or about to start, which bear on the question of testing high energy interactions models—is included. (auth)

27094 MEASUREMENT OF SMALL–ANGLE ELASTIC SCATTERING OF PIONS AND PROTONS BY NUCLEI. Blieden, H.R.; Finocchiaro, G.; Goldhaber, A.S.; Grannis, P.D.; Green, D.; Hietarinta, J.; Hochman, D.; Kephart, R.; Kirz, J.; Lee, Y.Y.; Nef, C.; Thun, R. (State University of New York at Stony Brook, Stony Brook, New York 11794); Faissler, W.; Tang, Y.W. Phys. Rev. D 11: No. 1, 14-28 (1 Jan 1975).

Targets made of C, Al, Cu, Pb, and U were exposed to π^+, π^-, and proton beams of 9.92 and 19.85 GeV/c (for p–Pb only) at the Brookhaven AGS. A magnetic spectrometer with spark chambers was used to detect elastically scattered particles in the Coulomb–nuclear interference region (5–35 mrad). Differential cross sections are presented and compared with an optical model, taking full account of multiple scattering in the target. (auth)

27095 NEW MEASUREMENT OF σ_{tot} IN PROTON–PROTON SCATTERING IN PURE SPIN STATES. de Boer, W.; Fernow, R.C.; Krisch, A.D.; Miettinen, H.E.; Mulera, T.A.; Roberts, J.B.; Terwilliger, K.M. (Randall Laboratory of Physics, The University of Michigan, Ann Arbor, Michigan 48104); Ratner, L.G.; O'Fallon, J.R. Phys. Rev. Lett. 34: No. 9, 558-559 (3 Mar 1975).

We have remeasured the total cross section for proton–proton scattering at 2–6 GeV/c in the spin states $\uparrow\uparrow$ and $\uparrow\downarrow$ perpendicular to the beam direction. With the reduced errors significant differences were found between the two cross sections. (auth)

27096 ELASTIC SMALL–ANGLE pp, pd, AND pn SCATTERING AT HIGH ENERGIES. Shafranova, M. G. (Joint Institute for Nuclear Research, Dubna). Sov. J. Part. Nucl. 5: No. 3, 259-277(Jan 1975).

The article surveys the experimental data on small–angle elastic pp, pd, and pn scattering at energies $\gtrsim 1$ GeV, and new methods for the investigation of these reactions. The energy dependence of the slope parameters and some features of the differential cross sections are considered, and results are presented of research on the behavior of the real part of the elastic–scattering amplitudes and the total elastic–scattering cross sections. Information is given on the deuteron form factor. The experimental results are compared with a number of asymptotic relations obtained on the basis of the general principles of the theory. The models known from the published literature are used to describe the scattering amplitudes. The real parts of the scattering amplitudes are compared with results of calculations based on the dispersion relations. (auth)

27097 NEW SCALING FORMULA FOR LARGE-TRANSVERSE-MOMENTUM PHENOMENA. Muraki, Y. (Tokyo Univ., Tanishi, Japan). Lett. Nuovo Cim.; 12: No. 7, 228-232(15 Feb 1975).

An interpretation of the large transverse momentum particle production processes in the high energy proton–proton interactions. The experimental data from these interactions have revealed that the inclusive hadron production cross section decreases slowly with the transverse momentum and the cross section at fixed transverse momentum increases with the total energy of the system. The total cross sections and the behavior of the rising mean transverse momentum are plotted. (JFP)

Strong (Meson-induced)

Refer also to abstracts 27074, 27075, 27079, 27080, 27082, 27318, and 27337.

27098 (CONF-720923-P1, pp 3-8) PARTIAL WAVE ANALYSIS OF THE A_1, A_2, AND A_3. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The 3π system produced in the reaction $\pi^-p \rightarrow p2\pi^-\pi^+$ was studied in the range from 5 to 40 GeV/c. The data determine the spin parities and dominant decay modes of the A_1, A_2, and A_3 and give information on their production amplitudes. The first two resonances decay by the $\rho\pi$ mode and the last by $f\pi$. The production cross sections, interference, and polarizations are also discussed. (JFP)

27099 (CONF-720923-P1, pp 78-94) PION CHARGE EXCHANGE. Nelson, J.; Wahlig, M. (Univ. of California, Berkeley). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

Previous results for the reaction $\pi^-p \rightarrow \pi^0n$ at 0.3 to 4.0 GeV/c are compared with the phase-shift solution for πN scattering. The total and differential cross sections are considered. (JFP)

27100 (CONF-720923-P1, pp 104-121) HEAVY VECTOR MESONS. Davier, M. (Stanford Linear Accelerator Center, CA). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The 1.6 GeV region is discussed in the review of heavy vector mesons. The $4\pi^\pm$ mass spectrum, quantum numbers, the $\gamma-\rho^1$ coupling constant, and search in hadronic processes are covered. It is pointed out that there is now good evidence from photoproduction and e^+e^- annihilation data for a $J^{PC} = 1^{--}$ $I = 1\rho^1$ state near 1.6 GeV. The properties of this state are described. But the resonant nature of the ρ^1 is still to be proven. It is noted that in the 1250-MeV region no new results were presented, and therefore, the ρ^1 (1250) is still missing. (JFP)

27101 (CONF-720923-P1, pp 122-131) $\bar{N}N$ REACTIONS AND MESON RESONANCES. Fields, T. (Argonne National Lab., IL). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

A brief commentary on antiproton experimental results which relate to the possible excitation of s-channel meson resonance of mass $m > 2M_p$ is given. There is found to be no definitive evidence for narrow s-channel resonances, but the existence of small broad structures is found. (JFP)

27102 (CONF-720923-P1, pp 132-144) SEARCH FOR NEW STRUCTURE. Flatte, S. M. (Univ. of California, Santa Cruz). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The discussion of the search for new structures covers the $K\bar{K}$ system near threshold, narrow structure in the high mass region, and the decay $A_2 = \omega\pi\pi$. (JFP)

27103 (CONF-720923-P1, pp 145-157) RADIATIVE DECAYS OF MESONS. Zichichi, A. (CERN, Geneva). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The review of the radiative decays of mesons proceeds following the order of increasing mass of the decaying meson. The decays of η, ω, χ^0, and ϕ are considered. (JFP)

27104 (CONF-720923-P3, pp 1-72) MESON RESONANCES. Diebold, R. (Argonne National Lab., IL). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 3.

Several narrow resonances were suggested in the 950 MeV region, but need confirmation. The ambiguity in the I = 0,S-wave $\pi\pi$ phase shift above the ρ was resolved in favor of the down solution. The phase changes rapidly near KK threshold, and the data are well fit with a pole at 980-371 MeV. Little variation with mass was found in the phase of the A_1 amplitude, suggesting that it is just kinematic enhancement. There could also be a resonance in this region, but even if it should exist, the mass and width are very uncertain. All high statistics A_2 experiments are well fit by a single Breit-Wigner and the old CERN MMS data were re-

analyzed and found to be less significant than originally believed. It seems very likely that the A_2 is an ordinary resonance. A clean high statistics sample of $B(1235) \rightarrow \pi\omega$ was obtained and yields the expected $J^{PC} = 1^+$. Several experiments have found a new resonance, $\rho^1 \rightarrow \rho^0\pi^+\pi^-$ with $M \sim 1.5$ and $\Gamma \sim 0.4$ GeV. None of the narrow high-mass objects reported previously were confirmed in spite of considerable effort. There are still no exotic mesons. (auth)

27105 (COO-1195-307) BACKWARD PRODUCTION IN $\pi^-p \rightarrow p\pi^+\pi^-\pi^-$ AT 8.0 GeV/c IN A STREAMER CHAMBER. Morris, G. R. (Illinois Univ., Urbana (USA). Dept. of Physics). 1975. 200p. Dep. NTIS $13.00.

Thesis.

A data sample is investigated consisting of 1227 events of the form $\pi^-p \rightarrow p\pi^+\pi^-\pi^-$ where the final state proton is produced fast and forward in the laboratory system. The data sample was obtained using an 8.0 GeV/c pion beam and the University of Illinois-ANL streamer chamber. The dominant feature displayed in the data sample is the quasi-two body production of ρN^* and fN^* intermediate states. No evidence is found for backward A_1 or A_2 production, but a three standard deviation enhancement in the $\pi^+\pi^-\pi^-$ mass distribution is observed near 1900 MeV/c^2. Cross section upper limits are obtained for backward A_1 and A_2 production. The ρN^* and fN^* intermediate states are investigated with regard to the peripheralism of the production mechanism and sequential decay of the meson and baryon systems. These processes appear to be consistent with the hypothesis of u-channel proton exchange as the dominant production mechanism. The possibility of enhancements in the $p\pi^-\pi^-$ and $p\pi^+\pi^-$ final states is investigated. (auth)

27106 (COO-2197-26) PION–NUCLEON INTERACTION AND MESONIC ATOMS. Progress Report, February 1, 1974–January 31, 1975. Rebka, G. A. Jr.; Kunselman, R. (Wyoming Univ., Laramie (USA)). 1975. Contract AT(11-1)-2197. 11p. Dep. NTIS $4.00.

During the year February 1, 1974 to January 31, 1975, research under Task A: pion-nucleon interactions at LAMPF has been completion of apparatus for and initial running of LAMPF Experiment #99, "Measurement of the Cross Section for $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ with a magnetic spectrometer". The magnetic spectrometer was assembled, tested, and found to perform most satisfactorily. As a by-product of tests with π-mesons incident on a polystyrene target, sufficient data were gathered to determine the elastic cross section for $\pi^+ + {}^{12}C$ at 250 MeV/c momentum in terms of the elastic cross section for $\pi^+ + p$. With the liquid hydrogen target installed, data were collected to determine the doubly differential production cross section $(d^2\sigma/dpd\Omega)$ for $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ at 300 and 350 MeV energy in terms of the elastic cross section for $\pi^- + p$. About 1500 events distributed over about 20 locations spaced uniformly in the accessible center of mass phase space were collected for each energy. Careful analysis of the data has only begun, but determination of the total cross section for single pion production to a 5 to 10% accuracy is expected. Mesonic atoms has included data collection of muonic-atom X rays for determination of nuclear charge distributions of some high atomic nuclei. Data were collected on atomic states that were not overly sensitive to the nuclear model but still sensitive to the nuclear deformation. Sigma-minus atomic X rays were analyzed for a determination of the magnetic moment of the sigma minus. Anti-proton atomic X rays were collected for determination of the strong interaction parameters between anti-protons and nuclei. A list of publications was included. (auth)

27107 (ERDA-3956-75-1) BUBBLE CHAMBER STUDIES OF HADRON AND PHOTON INTERACTIONS. Progress Report, 1 June 1974–31 May 1975. Bugg, W. M.; Condo, G. T.; Hart, E. L. (Tennessee Univ., Knoxville (USA)). 1975. Contract AT(40-1)-3956. 16p. Dep. NTIS $4.00.

Experimental research on hadron and photon interactions in a bubble chamber is summarized. (JFP)

27108 (SLAC-179(Vol. 2), pp 1-22) REACTIONS $\pi^-p \rightarrow \pi^0n$ AND $\pi^-p \rightarrow$ ETAN BETWEEN 20 GeV/c AND 100 GeV/c. Barnes, A. V. (California Inst. of Tech., Pasadena); Mellema, D. J.; Tollestrup, A. V.; Walker, R. L.; Dahl, O. L.; Johnson, R. A.; Kenney, R. W.; Pripstein, M. Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

Preliminary $d\sigma/dt$ distributions are presented for the pion charge exchange reaction $\pi^-p \rightarrow \pi^0n$ and for the related reaction $\pi^-p \rightarrow \eta n$. Incident π^- momenta were 20.7, 40.6, 66 and 101 GeV/c, obtained at the FNAL Meson Laboratory. The range of momentum transfer, t, covered by these data is $0 < -t < 1.4$ (GeV/c)^2 for the π^0 reaction, and $0 < -t < 1.2$ (GeV/c)^2 for η's. The effective Regge trajectories obtained from these and previous data are discussed. For the charge exchange reaction this effective trajectory reflects mainly the behavior of the ρ-trajectory, whereas in the η reaction the dominant exchange is the A_2. The relation between the new forward differential cross sections for $\pi^-p \rightarrow \pi^0n$ and the existing data on π^-p and π^+p total cross sections is examined. Besides the data on π^0's and η's, evidence is presented for the production of ω^0 and η' mesons, and for an enhancement in the f^0, A_2 mass region. (auth)

27109 (SLAC-179(Vol. 2), pp 43-75) SINGLE PARTICLE INCLUSIVE DATA IN THE (5 TO 30) GeV/c REGION. Moffeit, K. C. (Stanford Linear Accelerator Center, CA). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

The review of single-particle inclusive data covers new results mainly from a few electronic experiments which were designed to study the inclusive process in the 5 to 30 GeV range. The approach to scaling, the large transverse momentum behavior, the particle and antiparticle yields, and new data for kaon and proton yields are covered. (JFP)

27110 (SLAC-179(Vol. 2), pp 121-137) $K\pi$ FINAL STATE IN 13 GeV K^+ INTERACTIONS. Carnegie, R. K. (Stanford Linear Accelerator Center, CA). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

Some preliminary results are presented on $K\pi$ scattering from a wire spark chamber spectrometer experiment. The neutral $K\pi$ mass spectra and spherical harmonic moments up to 2.0 GeV in the $K\pi$ mass for the small momentum transfer region are presented, and some qualitative remarks are made about the $K\pi$ scattering features observed in the data. The K-892 and K-1420 resonances are discussed, and clear evidence for a broad spin-3 K^* resonance around 1800 MeV was observed. (JFP)

27111 ON THE BINDING ENERGY VALUES AND EXCITED STATES OF SOME $A \geq 10$ HYPERNUCLEI. Cantwell, T. (College of Technology, Kevin Street, Dublin, Ireland); Davis, D. H. (University Coll., London (UK). Dept. of Physics); Kielczewska, D.; Zakrzewski, J. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej); Juric, M. (Institut za Fiziku, Belgrade (Yugoslavia)); Krecker, U. (Akademie der Wissenschaften der DDR, Berlin); Coremans-Bertrand, G.; Sacton, J.; Tymieniecka, T. (Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)); Montwill, A. Nucl. Phys., A; 236: No. 2, 445-456(30 Dec 1974).

New binding energy values for the hypernuclei ${}^{10}_{\Lambda}$Be and ${}^{14}_{\Lambda}$C have been determined, while those of ${}^{13}_{\Lambda}$C and ${}^{15}_{\Lambda}$N have been reassessed. The existence of a narrow particle-unstable state of ${}^{12}_{\Lambda}$C is affirmed, but the previously quoted evidence for the existence of a narrow state of the ${}^{14}_{\Lambda}$N hypernucleus is shown to be invalid. (auth)

27112 AMPLITUDES AND EXCHANGE MECHANISMS FOR $\pi N \rightarrow f_0 N$. Martin, A. D. (Durham Univ. (UK)); Michael, C. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 84: No. 1, 83-92(6 Jan 1975).

Production amplitudes for the f_0 meson and for the lower spin background are obtained from an analysis of the angular distribution moments in 17 GeV/c $\pi^-p \rightarrow \pi^-\pi^+n$ data. The energy dependence is studied by also analyzing data at 4 GeV/c. The exchange mechanisms responsible are discussed and compared with those for $\pi N \rightarrow \rho N$. (auth)

27113 DIFFERENTIAL CROSS SECTIONS FOR ELASTIC π^-p SCATTERING AT 16 MOMENTA BETWEEN 996 MeV/c AND 1342 MeV/c. Barber, P. C.; Broome, T. A.; Duff, B. G.; Heymann, F. F.; Imrie, D. C.; Lush, G. J.; Mgbenu, E. N.; Potter, K. M.; Robbins, L. A.; Rosner, R. A. (University Coll., London (UK)). Nucl. Phys., B; 84: No. 1, 109-121(6 Jan 1975).

Differential cross sections for elastic scattering of negative pions on protons are presented for 16 momenta between 996 and 1342 MeV/c. The cross sections are compared with the predictions from published phase-shift analyses. (auth)

27114 EXPERIMENTAL STUDY OF THE FINAL STATE INTERACTIONS IN THE DECAYS OF ${}^4_{\Lambda}$H $\rightarrow \pi^-p^3$H AND ${}^4_{\Lambda}$He $\rightarrow \pi^-p^3$He. Krecker, U. (Akademie der Wissenschaften der DDR, Berlin); Kielczewska, D. (Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)); Tymieniecka, T. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej). Nucl. Phys., A; 236: No. 2, 491-499(30 Dec 1974).

Experimental results concerning the decay modes ${}^{4}_{\Lambda}H \rightarrow \pi^- p^3H$ and ${}^{4}_{\Lambda}He \rightarrow \pi^- p^3He$ are presented. A sample of ${}^{4}_{\Lambda}He \rightarrow \pi^- p^3He$ decays almost free from a contamination of other hypernuclear decay modes was selected. Some experimental distributions are compared with theoretical predictions. (auth)

27115 PRODUCTION OF ${}^{12}_{\Lambda}C$ BY K^- IN FLIGHT. Bonazzola, G. C.; Bressani, T.; Cester, R.; Chiavassa, E.; Dellacasa, G.; Fainberg, A.; Mirfakhrai, N.; Musso, A.; Rinaudo, G. (Turin Univ. (Italy). Instituto di Fisica). Phys. Lett., B; 53: No. 3, 297-300(9 Dec 1974).

The (K^-,π^-) reaction was studied on ^{12}C at p_K = 390 MeV/c with forward emitted π^- (Feshback–Kerman kinematics). ${}^{12}_{\Lambda}C$ is left in states with binding energies of the Λ-particle of -9 ± 2 and -1.5 ± 1 MeV; the relative differential cross-sections are 0.29 ± 0.10 and 0.74 ± 0.14 mb/sr. (auth)

27116 TOPOLOGICAL AND LEADING PARTICLE CROSS SECTIONS FOR 147 GeV/c π^--p INTERACTIONS. Fong, D. G.; Heller, M.; Shapiro, A. M.; Widgoff, M. (Brown Univ., Providence, R. I. (USA)); Bogert, D.; Johnson, M.; Chien, C. -Y.; Lucas, P.; Pevsner, A.; Zdanis, R. A. Phys. Lett., B; 53: No. 3, 290-296(9 Dec 1974).

Results are reported based on a study of π^-p interactions at 147 GeV/c in the FERMILAB 30-inch Proportional Wire Hybrid Bubble Chamber System. The topological cross sections have been measured, and the two-prong elastic and inelastic channels, separated. In addition, leading-particle cross sections have been extracted using the increased momentum resolution of the downstream proportional wire chambers. The results have been compared with other experiments and predictions of a simple fragmentation hypothesis. (auth)

27117 POSITIVE PARTICLE PRODUCTION AT LARGE TRANSVERSE MOMENTA IN THE FRAGMENTATION REGION. Barber, D. P. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 404-406(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Measurements of π^+, K^+ and proton production cross sections in the fragmentation region at x = 0.6 for a range of transverse momentum from 0.33 to 2.55 GeV are reported. (France)

27118 N AND Z SPECTROSCOPY. Bareyre, P. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 1, 223-226(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The new experimental results on πN → 2-body scattering, phase shift analyses of elastic and charge exchange π ± N and K + N scattering and partial wave analysis of the 3-body inelastic channels in π ± p and K + N scattering are reviewed. (France)

27119 RECENT SPECTROMETER RESULTS ON NONDIFFRACTIVE PROCESSES. Diebold, R. (Argonne National Lab., IL). J. Phys. (Paris), Colloq.; No. 1, 284-289(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

A sampling of recent results on nondiffractive processes is presented: backward elastic scattering and rho production, backward pion charge exchange, K_2 regeneration, rho^0 production, rho–ω interference, K^* production, K charge exchange, $K^0\Lambda$ and $K^0\Sigma^0$ production, antiproton-deuteron production and elastic cross-overs. (France)

27120 STUDY OF π^- CHARGE-EXCHANGE REACTIONS ON NUCLEI AT 48 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kachanov, V. A.; Kakauridze, D. B.; Kutyin, V. M.; Prokoshkin, Yu. D.; Razuvaev, E. A.; Semenov, V. K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). Nucl. Phys., B; 85: No. 1, 158-164(20 Jan 1975).

The charge-exchange cross sections were measured for π^- on Li, C, Al and Cu nuclei at momentum 48 GeV/c. By comparing the data obtained for nuclei with those for hydrogen under the same conditions the effective numbers of protons are defined. The conclusion is made that η^0 mesons are absorbed in nuclei weaker than π^0. The total cross section of η^0 interactions with the nucleon is determined to be $\sigma_{tot}(\eta^0 N) = 15 \pm 5$ mb in agreement with the quark model. (auth)

27121 DIFFERENTIAL CROSS SECTIONS FOR THE CHARGE EXCHANGE PROCESS $\pi^+p \rightarrow \pi^0(\pi^+p)$ AT 8, 16 AND 23 GeV/c. Deutschmann, M.; Honecker, R.; Rumpf, K. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Kundt, U.; Walter, M. (Akademie der Wissenschaften der DDR, Berlin); Idschok, U.; Hartmann, R. (Bonn Univ. (F. R. Germany). Physikalisches Inst.); Cocconi, V. T.; Coghen, T.; Humble, S. Nucl. Phys., B; 85: No. 1, 31-38(20 Jan 1975).

The differential cross section $d\sigma/dt'$ for the charge-exchange process $\pi^+p \rightarrow \pi^0(\pi^+p)$ at 8, 16 and 23 GeV/c is presented for several regions of the π^+p effective mass. It is found that the dip at $t' \approx 0.6$ $(GeV/c)^2$ which is observed in the Δ(1236) mass band becomes a less pronounced structure in the higher mass regions. However, while the slope of the $d\sigma/dt'$ distributions in the near-forward direction decreases strongly with increasing π^+p mass, there is no evidence that the observed structure moves to higher values of t' as the π^+p mass increases. These results are consistent with a Regge-exchange picture where the position of the dip is determined by the exchanged trajectory, but are inconsistent with a simple geometrical picture. (auth)

27122 STUDY OF THE REACTIONS $K^-p \rightarrow \Lambda^{0+}$ NEUTRALS IN THE C.M. ENERGY RANGE FROM 1580 TO 1750 MeV. London, G. W.; Yu, Y. P. (Brookhaven National Lab., Upton, N. Y. (USA)); Boyd, D.; Beggs, T.; Candlin, D. J.; Goshaw, A. T.; Venus, W. (European Organization for Nuclear Research, Geneva (Switzerland)); Kahn, S.; Lowys, J. P.; Wuthrick, J. P. (Ecole Polytechnique, 75-Paris (France)). Nucl. Phys., B; 85: No. 2, 289-310(27 Jan 1975).

Results on the channels $K^-p \rightarrow \Lambda^0\eta^0$, $\Lambda^0\pi^0$, $\Sigma^0\pi^0$, $\Lambda^0\pi^0\pi^0$ and $\Sigma^0\pi^0\pi^0$ are obtained in a K^-p formation experiment using 1 million photographs taken in a heavy liquid bubble chamber filled with a CF_3Br-C_3H_8 mixture. The results are compared with hydrogen bubble chamber (HBC) experiments and with experiments having full or partial gamma-ray detection. The $\Lambda^0\pi^0$ and Λ^{0+} neutral cross sections agree with HBC results. The $\Sigma^0\pi^0$ cross section does not exhibit a bump at 1670 MeV as previously seen in HBC experiments. The $\Lambda^0\pi^0\pi^0$ data are dominated by a $\Sigma(1385)\pi^0$ production. The $\Sigma^0\pi^0\pi^0$ data are consistent with the presence of some $\Sigma(1405)$ π^0 production. (auth)

27123 THE PHOTOPRODUCTION OF NEUTRAL PIONS FROM PROTONS BETWEEN 0.7 GeV AND 1.7 GeV. Barton, J. S.; Booth, P. S. L.; Carroll, L. J.; Holt, J. R.; Jackson, J. N.; Moscati, G.; Wormald, J. R. (Liverpool Univ. (UK)). Nucl. Phys., B; 84: No. 2, 449-466(13 Jan 1975).

Measurements of differential cross sections for pi-zero photoproduction from protons were made at angles between 60 and 140° c.m. in the photon energy range 0.7 to 1.7 GeV. The data are compared with the fits provided by three recent partial-wave analyses of pion photoproduction and some significant discrepancies observed. (auth)

27124 TEST OF QUARK MODEL PREDICTIONS IN THE REACTIONS $\pi^+p \rightarrow \omega\Delta^{++}$ AND $\rho^0\Delta^{++}$ AT 5 GeV/c. Lyons, L.; Karshon, U.; Eisenberg, Y.; Mikenberg, G.; Pitluck, S.; Ronat, E. E.; Shapira, A.; Yekutieli, G. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Nucl. Phys., B; 85: No. 1, 165-178(20 Jan 1975).

The well-known class-A quark model relations of Bialas and Zalewski are parametrised in a particular form, where one can compare the data with the predictions separately for the meson non-flip and flip parts, defined in the transversity frame. A 3-parameter fit to the joint decay angular distribution is performed on the experimental data, and the results are compared with the quark-model predictions for various regions of the four-momentum transfer. The effect of an s-wave state under the ρ^0 is discussed. (auth)

27125 THE PHOTOPRODUCTION OF NEUTRAL PIONS FROM PROTONS AT FORWARD ANGLES IN THE RESONANCE REGION. Booth, P. S. L.; Carroll, L. J.; Holt, J. R.; Jackson, J. N.; Range, W. H.; Sprakes, K. A.; Wormald, J. R. (Liverpool Univ. (UK)). Nucl. Phys., B; 84: No. 2, 437-448(13 Jan 1975).

Differential cross sections for the photoproduction of pi-zero mesons from protons were measured at angles between 10 and 70° c.m. in the energy range 0.85 to 1.30 GeV. The values are compared with the fits to pion photoproduction data from three recent partial-wave analyses. (auth)

27126 TOPOLOGICAL AND LEADING PARTICLE CROSS SECTIONS FOR 147 GeV/c π^-–p INTERACTIONS. Fong, D. G. (Brown Univ., Providence); Heller, M.; Shapiro, A. M. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 331-343(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Results are reported based on a study of π^-p interactions at 147 GeV/c in the FERMILAB 30-inch proportional wire hybrid bubble chamber system. The topological cross sections and separated two-prong elastic and inelastic channels were measured. In addition, leading particle cross sections were found using the increased momentum resolution of the downstream proportional wire cham-

bers. Results were compared with other experiments and predictions of a simple fragmentation hypothesis. (auth)

27127 EXOTICS, BARYON EXCHANGE, AND CHARM. Brabson, B. B. (Indiana Univ., Bloomington). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 314-331(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Recent experimental evidence related to searches for exotic mesons and charmed particles is described. In addition, evidence for exotic particle exchange is reviewed, and search experiments in progress are discussed. Upper limits of 2μb to 10μb were placed upon exotic meson production in forward processes while limits of 1μb to 2μb exist for exotic mesons produced in baryon exchange processes. (auth)

27128 K^+p INTERACTIONS AT 100 GeV USING A HYBRID BUBBLE-CHAMBER-SPARK-CHAMBER SYSTEM AND A TAGGED BEAM. Barnes, V.E.; Carmony, D.D.; Christian, R.S.; Garfinkel, A.F.; Morse, W.M.; Mulera, T.A.; Rangan, L.K. (Physics Department, Purdue University, West Lafayette, Indiana 47907); Diamond, R.N.; Erwin, A.R.; Harvey, E.H.; Loveless, R.J.; Thompson, M.A.; Winn, D.R. Phys. Rev. Lett. 34: No. 7, 415-418 (17 Feb 1975).

We studied K^+p interactions at 100 GeV with the Fermi National Accelerator Laboratory 30-in. hydrogen bubble chamber and associated spark-chamber system. We find $\sigma_{tot}(K^+p) = 18.7 \pm 1.8$ mb and $\sigma_{el}(K^+p) = 2.0 \pm 0.4$ mb. We present the charged-multiplicity distribution and its moments, and the charge-transfer distribution. The average inelastic charged multiplicity is $\langle n_c \rangle = 6.65 \pm 0.31$, and the two-charged-particle correlation functions are $f_2^{cc} = 4.52 \pm 1.32$ and $f_2^{--} = 0.47 \pm 0.35$. (auth)

27129 THE FRAGMENTATION $C^{12} \rightarrow 2p$ AT 4.0 AND 7.5 GeV/c. Azimov, S. A.; Igamberdyev, K. R.; Rizaev, Kh. A.; Usmanov, T. M.; Yuldashev, A. A.; Yuldashev, B. S. (Physico-Technical Institute, Uzbek Academy of Sciences). JETP Lett. 20: No. 7, 234-235 (5 Oct 1974).

It is shown that the structure functions in the semi-inclusive reactions $\pi^- C^{12} \rightarrow 2p + X$ are the same at 4.0 and 7.5 GeV/c. This fact does not contradict the limiting-fragmentation hypothesis. (auth)

27130 EXPERIMENTAL STUDY OF THE REACTION $\pi^- p \rightarrow \Lambda K^0$ AT BEAM MOMENTA BETWEEN 930 AND 1130 MeV/c. Knasel, T.M.; Lindquist, J.; Nelson, B.; Sumner, R.L.; Swallow, E.C.; Winston, R.; Wolfe, D.M. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637); Phillips, P.R.; Reibel, K.; Schwartz, D.M.; Stevens, A.J.; Romanowski, T.A.; Watson, J.M. Phys. Rev. D 11: No. 1, 1-13 (1 Jan 1975).

We have used an optical spark-chamber spectrometer to perform a systematic study of the reaction $\pi^- p \rightarrow \Lambda K^0$ at beam momenta between 930 and 1130 MeV/c. The cross section, angular distribution, and Λ polarization have been measured. We present our complete data from a sample of 11400 events along with Legendre polynomial coefficients for the angular distributions. No striking cross-section enhancement at ΣK threshold is observed, but there is evidence for a small cusp effect. A simple model which takes account of the ΣK channel provides a good fit to our data. (auth)

27131 REACTION $\pi^- p \rightarrow f^0 n$ IN THE MOMENTUM REGION UP TO 50 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakauridze, D. B.; Prokoshkin, Yu. D.; Sadovskii, S. A.; Khaustov, G. V. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 20: No. 6, 1214-1218(Dec 1974). (In Russian).

The mass spectrum of the $(\pi^0\pi^0)$ system in the final state of the reaction $\pi^- p \rightarrow \pi^0\pi^0 n$ is studied at 20 to 50 GeV/c momentum. A peak corresponding to f^0 meson is found in the mass spectrum. The f^0 meson production cross section decreases by a power law when the momentum increases. The differential cross section shows an exponential behavior, exp(bt), and is described by an effective trajectory close to zero. The mass spectrum of the unbound system $(\pi^0\pi^0)$ is satisfactorily described by a multi-Regge diagram with ρ and π meson exchange. (auth)

27132 REACTION $\pi^- p \rightarrow \Delta^{++}(1236)\pi^-\pi^-$ AT 4.5 GeV/c. Betetov, G. V.; Zombkovskii, S. M.; Kaidalov, A. B.; Kruchinin, S. P.; Pozhidaeva, N. A.; Selektor, Ya. M.; Turov, V. F.; Shulyachenko, V. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 6, 1196-1200(Dec 1974). (In Russian).

The 0.50- and 0.55-m liquid hydrogen bubble chambers were used to study the reaction $\pi^- p \rightarrow \Delta^{++}(1236)\pi^-\pi^-$ at 4.5 GeV/c momentum. The dependence of the differential cross sections and of the elements of the Δ^{++} density matrix upon the square of the transferred momentum are determined. The behavior of the differential cross sections $d\sigma/dt$ in the momentum transfer region up to 4.5 $(GeV/c)^2$ is well described by a sum of two exponentials. At momentum transfer up to ~0.6 $(GeV/c)^2$ the density matrix element ρ_{11} is close to $\frac{1}{2}$ and all others are close to zero, just as expected if the Δ^{++} isobar is predominantly produced via OPE. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 27849 and 27852.

27133 (CONF-720923-P1) PROCEEDINGS OF THE XVI INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS, CHICAGO-BATAVIA, ILLINOIS, SEPTEMBER 6-13, 1972. Volume 1. Parallel Sessions: Strong Interactions. Jackson, J. D.; Roberts, A.; Donaldson, R. (eds.). (Chicago Univ., Ill. (USA); National Accelerator Lab., Batavia, Ill. (USA)). 1972. 593p. Dep. NTIS $32.75.

The conference included 39 papers, one of which was abstracted previously in NSA as 28: 6810. Separate abstracts were prepared for 38 papers. (JFP)

For abstracts of individual papers see: 27055-27058, 27098-27103, 27134-27141, 27195, 27196, 27313-27315, 27353-27357, 27383-27390, 27456, and 27457.

27134 (CONF-720923-P1, pp 238-239) KNO SEMI-INCLUSIVE SCALING. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

A recent cross section relation, assuming only Feynman scaling, is discussed. But it is shown that for this relation to obtain, one must have KNO scaling. (JFP)

27135 (CONF-720923-P1, pp 330-346) CORRELATIONS IN MULTIPARTICLE PRODUCTION. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The treatment of correlations in multiparticle production covers the motivation for correlation studies, two-particle correlations, the correlation function, and correlations involving more than two particles at a time. (JFP)

27136 (CONF-720923-P1, pp 389-413) STRUCTURE OF INCLUSIVE SPECTRA AND FLUCTUATIONS IN INELASTIC PROCESSES CAUSED BY MULTIPLE-POMERON EXCHANGE. Abramovskii, V. A. (Inst. of Physics, Tbilisi, USSR); Kancheli, O. V.; Gribov, V. N. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

It is shown that even when multiple-Pomeron exchange and interactions of Pomerons are taken into account one may preserve the spectrum homogeneity (in the sense of inclusive cross sections) and $\bar{n} \sim \xi$. But the scale of averaging at which the uniform density is reached and the probability of fluctuations in each individual event are found to be quite different. (JFP)

27137 (CONF-720923-P1, pp 417-449) APPLICATIONS OF DUAL RESONANCE MODELS TO INCLUSIVE REACTIONS. Einhorn, M. B. (National Accelerator Lab., Batavia, IL). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The review of applications of dual resonance models to inclusive reactions covers dynamics, constraints on duality schemes from inclusive sum rules, and Reggeon-particle scattering. (JFP)

27138 (CONF-720923-P1, pp 475-478) OUTLOOK FOR DUAL THEORY. Lovelace, C.; Nambu, Y.; Sakita, B.; Susskind, L. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The discussion of the outlook for dual theory covers Regge cuts from dual models, comparison with the Gribov Reggeon calculus, the Neveu-Schwarz model for the calculation of the

twisted pomeron, and multipomeron cuts decoupling from external pions. The relativistic string is discussed including geometrization, and modification of the classical picture. Also the statistical or thermodynamic approach to predict multiplicities, the usefulness of two-dimensional field theory and functional integrals to understand the formal structure of dual models, and the possible distribution of internal quantum numbers over the string. (JFP)

27139 (CONF-720923-P1, pp 480-487) EIKONAL MODELS OF PRODUCTION AMPLITUDES. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

Work is reported in which S-matrix elements are constructed for production processes like NN → NN + k pions. The models are most remarkable since they satisfy, by construction, unitarity even in the multiparticle sectors. This achievement allows one to investigate in detail the effect that unitarity (in the direct channel) has on the output singularities in the angular momentum plane. In particular it is very amusing to see how an input amplitude of the multiperipheral variety, which in a normal multiperipheral model has no mechanism which forbids the leading output singularity from moving to the right of $l = 1$ at $t = 0$ and thus violating the Froissart bound, is forced by unitarity to move such unwanted singularities off the physical sheet in the l-plane and become quite harmless. The particular mechanism employed by the models is a square root branch point which "shields" all poles which attempt to move past $l = 1$. The study of such models is in its infancy but promises, at the very least, to provide a useful laboratory for discovering the detailed implications of s-channel unitarity on the l-plane singularity structure near $l = 1$ and $t = 0$ which is relevant to diffraction scattering. (auth)

27140 (CONF-720923-P1, pp 489-497) MULTIPERIPHERAL DYNAMICS: NONLINEAR ASPECTS OF REGGE BEHAVIOR. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

Pessimism was not, fortunately, the touchstone of the session. Indeed in Chew's report a discussion of nonlinear relations in hadron dynamics, the point was made that there are several approaches now being developed which promise to yield strong analytical tools for strong interaction dynamics. One matter especially emphasized in the discussion is that the very tiny contribution to total cross sections of multi-Pomeron exchange makes much of the study of cut discontinuities into a very detailed investigation of a numerically very small object. There was no disputing that small displacements of $\alpha_p(0)$ from one would eventually be important, only the repeated emphasis that from the point of view of understanding, say, the observed constancy of total cross sections in the regime even of ISR energies where log s in not yet large, one may be concentrating on the wrong aspect of the dynamics. (auth)

27141 (CONF-720923-P1, pp 504-517) INCLUSIVE PROCESSES AT HIGH TRANSVERSE MOMENTUM. Blankenbecler, R.; Brodsky, S. J.; Gunion, J. F. (Stanford Linear Accelerator Center, CA). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The interchange theory for inclusive scattering at large transverse momentum is extended into kinematic regions where Regge effects are important. Hadronic bremsstrahlung is shown to inevitably lead to Reggeization of the fundamental production process as s goes to infinity for fixed, large p_T. The cross sections are shown to rise to their ultimate scaling limit. This transition zone connects smoothly with the Feynman scaling region at low p_T, and the deep scale-invariant region at large $p_T \sim 0(\sqrt{s})$. The inclusive results of the interchange theory have the form of the standard fragmentation, triple Regge, and pionization formulas in their respective regions, but in addition predict the behavior of the associated residues and trajectories at large t or p_T^2. (auth)

27142 (CONF-720923-P2, pp 135-165) CURRENT ALGEBRA: QUARKS AND WHAT ELSE? Fritzsch, H.; Gell-Mann, M. (CERN, Geneva). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The discussion of current algebra and quarks covers fictitious quarks and gluons and their statistics, a review of current algebra, a summary of light cone and null plane results, further extensions of null plane algebra, and alternative models. (JFP)

27143 (CONF-720923-P2, pp 166-168) A COMMENT ON SATURATION OF THE ADLER SUM RULE. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

A critical analysis is made of the saturation of the Adler sum rule. Although several authors conclude that the sum rule is not saturated even in the multi-GeV region, it is believed that there is still enough freedom for the sum rule to be saturated for a value of $x > 0.050$ to 0.025. (JFP)

27144 (CONF-720923-P3, pp 165-217) INELASTIC TWO-BODY REACTIONS. Michael, C. (CERN, Geneva). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 3.

Two-body and quasi-two-body reactions above 3 GeV/c are reviewed. The spin dependence of reaction amplitudes and baryon polarization data, the energy dependence of specific reactions, baryon exchange data, and two-body reaction information are covered. Concentration is placed on subjects which are theoretically and phenomenologically either rather elegant or particularly puzzling or in which significant advances in available data were made. (JFP)

27145 (CONF-720923-P3, pp 373-458) HIGH ENERGY COLLISIONS: PRODUCTION PROCESSES AT HIGH ENERGY THEORY AND EXPERIMENT. Jacob, M. (CERN, Geneva). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 3.

The summary of production processes at high energy covers the general features of production processes, scaling and the approach to scaling, and correlations as a probe of production processes. (JFP)

27146 (CONF-720923-P3, pp 491-506) PROBLEMS OF DIFFRACTION SCATTERING IN RELATIVISTIC THEORY. Gribov, V. N. (Inst. of Nuclear Research, Leningrad). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 3.

The treatment of diffraction scattering in relativistic theory includes the properties of the pomeron, diffraction dissociation, cross section relations in relativistic theory, differences from diffraction on a large object, the possibility of asymptotic equality of total cross sections, and the asymptotic behavior of the total cross sections. (JFP)

27147 (CONF-720923-P4) PROCEEDINGS OF THE XVI INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS, CHICAGO–BATAVIA, ILLINOIS, SEPTEMBER 6–13, 1972. Volume 4. Parallel Sessions: Mostly Currents and Weak Interactions. Jackson, J. D.; Roberts, A.; Donaldson, R. (eds.). (Chicago Univ., Ill. (USA); National Accelerator Lab., Batavia, Ill. (USA)). 1972. 380p. Dep. NTIS $22.00.

The conference included eight papers, one of which was abstracted previously in NSA as 31: 2036. Separate abstracts were prepared for seven papers. (JFP)

For abstracts of individual papers see: 25903, 27018, 27032, 27202, 27203, 27285, and 27286.

27148 (COO-1545-151) FOUR REGGEON COUPLINGS IN TWO PARTICLE INCLUSIVE DATA. Pinsky, S. S. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1974. 10p. Dep. NTIS $4.00.

Motivated by theoretical studies of Reggeon field theories with direct four Reggeon couplings, the phenomenological implications of such a coupling. In particular, one calculates the contribution to two particle inclusive reactions of a direct four Reggeon coupling, and shows that: they are accessible at presently available energy, they give rise to dramatic effects, the data seem to show evidence of these effects, and the coupling appears large. (auth)

27149 (FERMILAB-75/15-THY) ESTIMATES OF ASSOCIATED CHARM PRODUCTION CROSS SECTIONS. Field, R. D.;

Quigg, C. (National Accelerator Lab., Batavia, Ill. (USA)). Jan 1975. 10p. Dep. NTIS $4.00.

Associated charm production is related to measured two-body reactions. Very generous estimates are unobservably small. (auth)

27150 (NORDITA-191) PROGRESS REPORT FOR 1973. Nordita Report. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). [nd]. 43p. (In Danish and English). Dep. NTIS (US Sales Only) $5.25.

The summary of research consists primarily of a list of publications and colloquia concerned mainly with nuclear and particle physics. (JFP)

27151 (NP-20294-P1, pp vp Paper 1) INTRODUCTION TO INCLUSIVE SPECTRA. Krzywicki, A. (Paris Univ., Orsay, France). 1973. (In French).

In summer school on particle physics, Gif-sur-Yvette, France, 24 September–6 October 1973. Volume I.

A definition of inclusive and exclusive experiments is given, the elementary properties of inclusive spectra are presented and inclusive-exclusive connection is studied. The hypothesis of short-range correlations is introduced, and the case of correlations between discrete quartum numbers is treated. (FR)

27152 (NP-20294-P2, pp vp Paper 2) INTRODUCTION TO FIELD QUANTIZATION (PERTURBATIVE LAGRANGIAN THEORIES). Stora, R. (CERN, Geneva). 1973. (In French).

In summer school on particle physics, Gif-sur-Yvette, France, 24 September–6 October 1973. Volume II.

The quantum field theory is an approach to the description of particle interactions. The following problems are treated: mathematical definition of a particle, mathematical definition of a set of particles without interaction, theoretical framework of a collision theory, free quantum field associated with a particle, local and global observables associated with a free field derived from a Lagrangian, dynamical models for the scattering operator: perturbative expansion. (FR)

27153 (RLO-2041-123) ANNUAL REPORT, 1974. Moravcsik, M. J. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 15 Nov 1974. Contract AT(45-1)-2230. 6p. Dep. NTIS $4.00.

Theoretical high energy physics is summarized. A list of publications is included. (JFP)

27154 (SLAC-179(Vol. 1), pp 1-177) DIFFRACTIVE PROCESSES. Leith, D. W. G. S. (Stanford Linear Accelerator Center, CA). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume I.

The lectures are intended to review diffractive processes. The available data are summarized as well as what they teach about the structure of the proton and the dynamics of high energy scattering. Total cross sections and elastic scattering, photoproduction of vector mesons, diffraction dissociation (exclusive inelastic diffraction), the rules of diffraction, inclusive inelastic diffraction, triple Regge phenomenology, and inpact parameter analysis of high energy scattering are covered. (JFP)

27155 (SLAC-179(Vol. 2), pp 259-277) RECENT PROGRESS IN THE PHENOMENOLOGY OF LARGE TRANSVERSE MOMENTUM REACTIONS. Brodsky, S. J. (Stanford Linear Accelerator Center, CA). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

Some of the experimental implications of the constituent picture of hadrons for large transverse momentum phenomena are reviewed. Hard-scattering models, the structure of the hard scattering models and dimensional counting, dimensional counting and exclusive reactions, applications to inclusive reactions, particle ratios at large transverse momentum, applications to photon processes, and the constituent interchange models are covered. (JFP)

27156 (USIP-74-22) ALGORITHMS FOR EXAMINING KINEMATICAL SINGULARITIES AND ZEROS IN PARTICLE REACTIONS. Enflo, B. O.; Laurent, B. E. (Stockholm Univ. (Sweden). Fysiska Institutionen). Sep 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

General methods for the study of kinematical singularities and constraints are discussed. They are not confined to particular spins or number of particles in a reaction. Singularities and zeros are divided into accidental ones, which depend on the spin reference system chosen, and permanent ones. The latter ones are connected with fermion conservation and intrinsic-parity projection. A simple example is given. (auth)

27157 UNIVERSALITY IN THE ALGEBRA OF VERTEX STRENGTHS AS GENERATED BY BILOCAL CURRENTS. Ne'eman, Y. (California Inst. of Tech., Pasadena (USA)); Reddy, V. T. N. (Texas Univ., Austin (USA). Center for Particle Theory). Nucl. Phys., B; 84: No. 1, 221-233(6 Jan 1975).

The derivation of the algebra of vertex strengths (AVS) from the algebra of current bilocals on the null plane in the deep Regge scaling region (DRSR) is reviewed. The difficulties are discussed and a mathematical procedure is presented yielding AVS through a smooth removal of the divergent ω^{α} dependences which differ on both sides of the infinite "ω-local" algebra of scaling functions. It is suggested that the S_a charges in AVS (the 2^{++} trajectories' vertex strengths) may be given by the antisymmetrized matrix elements of the vector bilocals. (auth)

27158 UNIVERSALITY OF THE BASIC INTERACTIONS. Fritzsch, H.; Minkowski, P. (California Inst. of Tech., Pasadena (USA)). Phys. Lett., B; 53: No. 4, 373-376(23 Dec 1974).

The unification of weak, electromagnetic and strong interactions is proposed within a gauge theory based on the chiral group of elementary fermions (quarks and leptons). Several consequences, in particular, one with respect to neutral currents in the weak interactions, are discussed. (auth)

27159 SCALING PROPERTIES OF A GAUGE THEORY WITH HAN–NAMBU QUARKS AND CHARGED VECTOR GLUONS. Cheng, T. P. (Missouri Univ., St. Louis (USA)); Wilczek, F. (National Accelerator Lab., Batavia, Ill. (USA)). Phys. Lett., B; 53: No. 3, 269-271(9 Dec 1974).

A renormalizable gauge theory of strong and electromagnetic interactions with integrally charged quarks is constructed, and its scaling behavior is analyzed. (auth)

27160 PERCUS–YEVICK VIRIAL RELATION AND SCALED PARTICLE THEORY. Ahn, S.; Frisch, H. L. (State Univ. of New York, Albany). J. Statist. Phys.; 11: No. 4, 283-289(Oct 1974).

The conditional probability of finding a cavity G(r) devoid of molecular centers of hard sphere fluid is modified by making use of the discontinuity at $r = a/2$ (a is the diameter of a molecule). The new equation of state thus obtained is bounded by the Percus–Yevick compressibility and virial pressure equations of state, which may be the upper and lower bounds to the results of machine calculation. (auth)

27161 STATISTICAL AND HYDRODYNAMICAL MODELS OF MULTIPLE HADRON PRODUCTION. Feinberg, E. L. (Inst. of Physics, Moscow). J. Phys. (Paris), Colloq.; No. 1, 356-362 (1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

All such models can be classified into two groups: models of the Fermi types, in which thermodynamical equilibrium arises in a fixed volume independent of collision energy; these models agree with experiment only if the concept of an upper bound for the temperature is introduced; models of the Pomeranchuk, or Landau, or more generally Pomeranchuk-Landau type, where the statistical system evolves in space and time. (France)

27162 HIGH TRANSVERSE MOMENTUM PROCESSES. Bjorken, J. D. (Stanford Linear Accelerator Center, CA). J. Phys. (Paris), Colloq.; No. 1, 385-399(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The following topics are covered: single-particle inclusive hadron spectra at high transverse momentum: structure of high transverse momentum hadronic events; theoretical models and interpretation; inclusive production of high transverse momentum leptons and lepton pairs, along with limits on production of $W^{\pm}$, Z^0 and other massive objects; multiple cores and high transverse momentum phenomena at still higher energies. (France)

27163 DIFFRACTIVE DISSOCIATION: THEORIES. Zalewski, K. (Inst. of Nuclear Physics, Krakow). J. Phys. (Paris), Colloq.; No. 1, 274-276(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The theory of exclusive, few-body diffraction dissociation processes is presented. (France)

27164 MODELS FOR RISING CROSS-SECTIONS. Caneschi, L.; Ciafaloni, M. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 268-273(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

A brief review of the models that have been proposed to explain the rising of σ_T in the ISR energy range is given: models that emphasize the role of t-channel angular momentum and unitarity, models that emphasize the S-channel angular momentum and unitarity, and models that connect the rise of σ_T to the vast increase of the rate of rare processes at the ISR. (France)

27165 S-CHANNEL PHENOMENOLOGY OF DIFFRACTION SCATTERING. Miettinen, H. I. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 263-267(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The shadow approach to diffraction scattering is presented. (France)

27166 ELASTIC SCATTERING AND LOW MULTIPLICITIES. Amaldi, U. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 241-259(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The following subjects are treated: nondiffractive processes (charge exchange at high energy, K^0 regeneration, energy dependence of quasi two-body and few-body processes, understanding quasi-two-body processes, exotic exchanges), and diffractive processes (exclusive diffraction dissociation, elastic scattering, real parts of the forward nuclear amplitudes, total cross sections, proton-proton absorption in the ISR energy range). (France)

27167 SOME THEORETICAL PROBLEMS RELATED WITH NON RESONANT ENHANCEMENTS. Cohen-Tannoudji, G. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 1, 235-238(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

A brief survey of theoretical interpretations of nonresonant enhancements (Deck mechanism, the Q cross-over, duality in diffractive production) is presented. It is shown that the explanation of the so-called ABC effect proposed by Anjos, Levy and Santoro is particularly interesting. (France)

27168 PARTICLE PRODUCTION WHEN CROSS SECTIONS GROW. Zachariasen, F. (California Inst. of Tech., Pasadena). J. Phys. (Paris), Colloq.; No. 1, 379-381(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The results obtained by multiperipheral and diffractive models in the analysis of particle production cross sections are compared. (France)

27169 MUELLER–REGGE PHENOMENOLOGY. Chan, Hong-Mo. (Science Research Council, Chilton, Eng.). J. Phys. (Paris), Colloq.; No. 1, 352-355(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Single particle distributions are calculated both in the fragmentation region and in the central region, in the framework of Mueller-Regge phenomenology. (France)

27170 IMPRECISION DESCRIPTION OF THE THRESHOLD BEHAVIOR OF THE HIGH-ENERGY PAIRS ANNIHILATION AND PRODUCTION PROCESSES. Papp, E. (Institutut Politechnic, Cluj). Int. J. Theor. Phys.; 10: No. 2, 123-143(Jul 1974).

The time operators corresponding to the whole Dirac and Klein-Gordon fields and the expressions of the time imprecisions associated to the pairs annihilation and subsequent production processes have been evaluated. In these conditions there exists the possibility of assuming the existence of a threshold behaviour of the above processes. Certain peculiarities of the threshold behavior obtained in this way are related with certain results obtained by virtue of the imprecision description of the coulomb interaction. Finally, the meaning and role of the electromagnetic natural space unit is also discussed. (auth)

27171 PHENOMENOLOGICAL MODELS OF MULTIPLE PRODUCTION. Bassetto, A. (Univ., Padua). J. Phys. (Paris), Colloq.; No. 1, 341-345(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

It is shown that neither fragmentation (or Nova) models nor multiperipheral models give a good picture of multiple production. (France)

27172 HIGH MULTIPLICITY REACTIONS (THEORY). Mueller, A. (Columbia Univ., New York). J. Phys. (Paris), Colloq.; No. 1, 307-315(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Models proposed to fit the data on multiple particle production are discussed. They include: two component models, eikonal and absorption models (Chang-Wu and Chang-Yan type models, unitarity models, and the Finkelstein-Zachariasen model). (France)

27173 HYPERCHARGE EXCHANGE AMPLITUDE ANALYSES. Aguilar-Benitez, M. (Junta de Energia Nuclear, Madrid). J. Phys. (Paris), Colloq.; No. 1, 301-302(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

A brief survey of new results on hypercharge exchange reactions is presented. Amplitude analyses appear to be a powerful tool to test the predictions of various models. (France)

27174 MODELS FOR NON-DIFFRACTIVE TWO-BODY REACTIONS. Ringland, G. A. (Rutherford High Energy Lab., Chilton, Eng.). J. Phys. (Paris), Colloq.; No. 1, 292-295(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

In this brief review of reaction mechanisms for (quasi) two-body scattering, problems and difficulties of Regge cut models are emphasized. The most recent exchange models and detailed difficulties in useful extrapolations to low energies are mentioned. The problem of satisfying FESR with these models is emphasized. The applicability of any Mandelstam cut-corrected Regge exchange model is analyzed. (France)

27175 DUAL RESONANCE MODELS. Goddard, P. (Univ., Durham, Eng.). J. Phys. (Paris), Colloq.; No. 1, 160-166(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

It is shown that the understanding of dual resonance models has progressed much in the following fields: the structure of physical states and the construction of physical state projection operators; proof that the pomeron singularity generated by the model is a pole (under suitable circumstances) and proof that the consequent model for pomeron scattering is ghost free; the gauge properties of the dual fermion model is ghost free if the fermion mass is zero, and it couples consistently to dual mesons. (France)

27176 LIMITING TRENDS VISIBLE AT LOWER ENERGIES. Wahl, H. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 373-378(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The results on many body neutrons obtained in the momentum range up to 30 GeV/c are presented: single particle production, charge distributions and charge exchange, triple Regge formula, and early scaling and exoticity criteria. (France)

27177 REGGE EXTRAPOLATION TO THE RESONANCE REGION. Alcock, J. W.; Chao, Y. A.; Cutkosky, R. E. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). Nucl. Phys., B; 84: No. 2, 503-530(13 Jan 1975).

The structure of dual amplitudes (beta functions) suggests that in nonexotic channels one should add to the usual Regge terms a second term which drops off as exp ($^-\pi$ Im $\alpha(s)$) at large s but which is important for $s \lesssim 5$ GeV^2. This "dual correction" multiplies the usual Regge imaginary part by an oscillating complex factor. With inclusion of such extra terms, it is possible to match πp amplitudes from phase-shift analyses significantly better than if the terms are omitted. The partial waves of a modified fit using the leading N, Δ, ρ, f trajectories with a fixed-pole pomeron show much more of the correct resonant structure than do those of an unmodified fit. (auth)

27178 RENORMALIZATION GROUP ANALYSIS OF THE THEORY OF INTERACTING POMERONS. Calucci, G.; Jengo, R. (Trieste Univ. (Italy). Istituto di Fisica Teorica). Nucl. Phys., B; 84: No. 2, 413-436(13 Jan 1975).

A detailed analysis of the behaviour near $J = 1$ and $k_\perp = 0$ of the theory of interacting pomerons is performed by means of the renormalization group techniques in the version developed by Wilson. Those techniques deal with the bare field theoretical Lagrangian and allow one to study very general forms of the interactions. Following those procedures the strong coupling solution and two different forms of the weak coupling solution are found. The relevance of those solutions for the behaviour of diffractive scattering is briefly discussed. (auth)

27179 PARTICLES AND FIELDS: 1974. Conference Held at Williamsburg, Virginia, September 5–7, 1974. Carlson, C. E. (Ed.). AIP Conference Proceedings Number 23, Particles and Fields Subseries No. 10. New York; American Institute of Physics (1975). 701p. (CONF-740933-).

Separate abstracts were prepared for the 35 papers presented. (JFP)

For abstracts of individual papers see: 27038, 27048–27052, 27090–27093, 27126, 27127, 27180–27184, 27237–27240, 27300–27303, 27345–27347, 27371, 27425, 27444, 27468, and 27874–27876.

27180 TRANSPORT EQUATION APPROACH TO MULTIPARTICLE PRODUCTION PROCESSES. Carruthers, P. (Los Alamos Scientific Lab., NM); Zachariasen, F. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 481-498(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A transport equation approach to particle production in high energy collisions is developed in particular field theory models. The covariant analog of the Boltzmann distribution function (the Fourier transform of a suitable correlation function) is shown to obey a transport equation, or more precisely a set of such equations. The crucial approximation involved in the derivation is similar to the random phase approximation or Hartree approximations traditionally used in many-body theory. Noncovariant examples (employing the Wigner distribution function) are worked out to illuminate the physical content of the approach. (auth)

27181 LANDAU'S HYDRODYNAMIC MODEL OF PARTICLE PRODUCTION. Cooper, F. (Yeshiva Univ., New York). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 499-531(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Landau's hydrodynamic description of multiparticle processes are reviewed, and it is shown how to calculate single particle inclusive distribution functions in terms of the collective variables of such a description. In the scaling regime, the hydrodynamic equations for simple initial conditions expected to be appropriate in pp collisions and in e^+e^- annihilation into hadrons are solved analytically. One then discusses how these scaling solutions relate to more exact numerical calculations of $E dN/d^3p$ obtained for comparison with present accelerator data. (auth)

27182 SELF-CONSISTENT MODELS OF THE POMERON. Zachariasen, F. (California Inst. of Tech., Pasadena). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 532-550(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A review is presented of three models of diffraction scattering based on self-consistent solutions to the s-channel unitarity relation. The major theoretical and experimental predictions of the models are tabulated, and compared qualitatively with each other and with existing high energy data. (auth)

27183 INCLUSIVE AND EXCLUSIVE PROCESSES AT LARGE TRANSVERSE MOMENTUM: A COMPENDIUM. Gunion, J. F. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 551-571(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

The predictions of the constituent interchange theory are summarized in a unified way for inclusive and exclusive processes at high transverse momenta using a unified approach. (JFP)

27184 HIGH ENERGY PHYSICS WITH COSMIC RAYS. Trefil, J. S. (Univ. of Virginia, Charlottesville). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 623-659(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A review is given of the behavior of elementary particle interactions at energies above what the present generation of accelerators can provide as determined from cosmic ray physics. Particle–nucleus interactions at high energies, the p–p total cross sections, and cosmic showers are considered. (JFP)

27185 UNIVERSALITY OF INCLUSIVE RAPIDITY DISTRIBUTIONS. Likhoded, A.K.; Tolstenkov, A.N. (Institute of High Energy Physics, USSR Academy of Sciences). JETP Lett. 20: No. 7, 223-224 (5 Oct 1974).

It is shown that all the distributions $E(d^3\sigma/d^3p)$ for the inclusive reactions $a+b\to c+X$ in the rapidity region $Y_{lab}<\ln(\sqrt{s}/m_p)$ are described by a single function of the rapidity Y_{lab}, accurate to within a shift $Y_{lab}\to Y_{lab}+\text{const}$. (auth)

27186 THE SUPERSELECTION STRUCTURE OF PARTICLE PHYSICS. Haag, R. (Hamburg Univ. (F. R. Germany). 2. Inst. fuer Theoretische Physik). J. Phys. (Paris), Colloq.; No. 1, 107-110(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The origin of charge quantum numbers and statistics in relativistic local quantum theory with short-range forces and the classification of the possibilities allowed by the basic principles are discussed. (FR)

27187 UN-SECTOR AND COMPOSITENESS CONDITIONS IN THE BRONZAN–LEE MODEL. Choudhury, A. L. (Elizabeth City State Univ., N. C. (USA). Dept. of Mathematics). Z. Naturforsch., a; 29: No. 11, 1531-1542(Nov 1974).

The Lehmann–Symanzik–Zimmermann (LSZ) technique has been used to calculate all τ-functions of the UN sector of the Bronzan–Lee model. Using the prescription of Liossatos, the $Z_V\to 0$ limit has been carried out for the Fourier transform of the τ-functions in the sector. These limiting functions $\tau^{UN}_{0,L}$ are then compared with the $\tau^{UN}_{0,\alpha}$ functions derived from a composite model proposed by the foregoing author, where V is considered to be a composite particle. It has been found that, when the so-called composite V particle does not appear in the initial and the final states, these τ-functions coincide. On the other hand, the limiting values of some τ-functions differ from those of the composite model when such particles appear in the final or initial states. (auth)

27188 APPROXIMATION OF EQUIVALENT PHOTONS FOR NEUTRAL FERMI PARTICLES. Grats, Yu. V.; Pavlenko, Yu. G. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 5, 615-618 (1974). (In Russian).

The interaction of fast particles with neutral Fermi particles having abnormal magnetic moments are examined by the Weizsaeker-Williams method. (JSR)

27189 APPROXIMATE PRODUCTION AMPLITUDES WITHOUT COMPLEX SINGULARITIES. Cunningham, J. (University Coll. of North Wales, Bangor). Acta Phys. Acad. Sci. Hung.; 36: No. 4, 401-414(1974).

A decomposition of the five point single loop amplitude into a sum over four point amplitudes is used to suppress the contributions of some contracted diagrams at and near specified values of the fixed invariants in such a way as to admit the possibility of single variable dispersion relations without the use of complex integration contours. (auth)

27190 ONE-LOOP DIVERGENCES OF NONLINEAR SIGMA-MODEL. Tamura, S. (Hokkaido Univ., Sapporo). Lett. Nuovo Cim.; 12: No. 8, 246-248(22 Feb 1975).

A previous algorithm to obtain the one-loop counter-Lagrangian in a continuous dimensional regularization was used to calculate the one-loop counter Lagrangian of the nonlinear sigma model with chiral-symmetry-breaking interaction. The nonrenormalizability of this model is discussed. (JFP)

27191 DIFFRACTION SCATTERING OF A VECTOR PARTICLE. Aliev, M. K. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 5, 42-46 (1974). (In Russian).

The previously formulated principle of Huygens for particles with an arbitrary spin is applied to the concrete case of diffraction scattering of a vector particle on a "black" target. (SJR)

27192 EVANESCENT COUPLINGS AND COMPENSATION OF ADLER ANOMALY. Bollini, C. G.; Giambiagi, J. J. (Universidad Nacional, La Plata). Acta Phys. Austr.; 38: No. 2, 211-215 (1973).

Within the context of dimensional regularization the idea of evanescent couplings, i.e., terms which go to zero for $\nu\to 4$, but giving finite contributions when inserted in divergent loops, is discussed. They are applied to compensate Adler anomaly in gauge theories. (auth)

27193 CONNECTION BETWEEN CONSERVATION LAWS AND INVARIANCE GROUPS: FOLKLORE, FICTION, AND FACT. Havas, P. (Temple Univ., Philadelphia). Acta Phys. Austr.; 38: No. 2, 145-167(1973).

The nature of the connection between the conservation laws and the invariances of a physical system is examined, using the Newtonian dynamics of a system of mass points as an example. For forces derivable from a potential depending on the mutual separations of the particles, the ten classical conservation laws can be related to the Galilei invariance of the action integral; however, as demonstrated, Galilei invariance of either the action integral or of the equations of motion is not sufficient to obtain conservation laws of the standard form or physical significance. It is shown that the equations of motion with arbitrary velocity-dependent forces are always equivalent to a set of equations derivable from a varia-

tional principle. Nevertheless, even if the equations are Galilei-invariant, this does not assure the existence of the usual conservation laws. In particular, the Hamiltonian does not reduce to the energy for forces derivable from a potential, and cannot be used to formulate a statistical mechanics or a quantum theory for more general forces. Various other questions concerning the relation between symmetries and conservation laws are discussed. (auth)

27194 POLARIZATION MEASUREMENTS IN NUCLEAR PHYSICS. Robson, B. A. (Australian National Univ., Canberra). Aust. Phys.; 12: No. 1, 3-6(Jan 1975).

An indication is given of the significance of polarization experiments in nuclear physics, that is, the study of nuclear phenomena which arise as a direct consequence of the intrinsic spin of some particle or system of particles. It is shown that polarization measurements are not only useful but essential for a complete understanding of nuclear structure and interactions. The case of polarized light is considered. (JFP)

Electromagnetic

Refer also to abstracts 27295, 27437, 27445, 27788, 27832, 27860, 27930, and 28902.

27195 (CONF-720923-P1, pp 450-455) CURRENTS IN DUAL MODELS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

A theory of currents in dual models is constructed using the continuation of mass-shell for scalar particles and the modification for vector currents. Photo- and electroproduction are considered. (JFP)

27196 (CONF-720923-P1, pp 456-459) DUALITY IN ELECTROPRODUCTION, NEW RESULTS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

In two-body hadron scattering it is believed that the normal Regge trajectories are dual to resonances in the crossed channel. It is shown that something similar happens in electroproduction. (JFP)

27197 (CONF-720923-P2, pp 8-18) RECENT THEORETICAL WORK ON e^+e^- ANNIHILATION AND CONTINUATION FROM INELASTIC ELECTRON SCATTERING. Drell, S. D. (Stanford Linear Accelerator Center, CA). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The treatment of e^+e^- annihilation and continuation from inelastic electron scattering covers the parton model and light cone algebra. Inclusive cross sections and structure functions are considered. (JFP)

27198 (CONF-720923-P2, pp 19-27) HADRON PRODUCTION IN e^+e^- COLLISIONS: ONE- AND TWO-PHOTON PROCESSES. Brodsky, S. J. (Stanford Linear Accelerator Center, CA). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The various components of hadron production in e^+e^- collisions are reviewed including an evaluation of the possibility of detecting neutral weak currents in purely leptonic amplitudes. One- and two-photon annihilations, hadronic photon emission, hard photon emission, the double fireball process, the two-photon process, and weak interactions are discussed. (JFP)

27199 (CONF-720923-P2, pp 122-129) PERTURBATION THEORY AND THE LIGHT CONE. Christ, N. (Columbia Univ., New York). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The matrix element for the simple scaling behavior observed for the structure functions W_1 and νW_2 in the SLAC deep inelastic electron-scattering experiments is considered. The high q^2 and ν behavior of this matrix element when computed in renormalized perturbation theory is discussed. (JFP)

27200 (CONF-720923-P2, pp 132-134) AXIAL CURRENT ANOMALIES. Zee, A. (Rockefeller Univ., New York). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The relevance of field theory for phenomena involving hadrons is discussed assuming the renormalized perturbation theory converges for a given process. It is considered whether one can calculate some hadronic quantities to any finite order in coupling constants and hence confront the series with experiment. (JFP)

27201 (CONF-720923-P2, pp 299-306) THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTIONS EMPLOYING THE HIGGS PHENOMENON. Bjorken, J. D. (Stanford Linear Accelerator Center, CA). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The status of efforts to make a realistic renormalizable theory of weak and electromagnetic interactions embodying the Higgs spontaneous-breakdown mechanism is described. Two possible ways of evaluating them are found. The first criterion is whether the theories are believable and the second is whether the theories are not in contradiction with experiment. Theories using $SU(2) \times U(1)_Y$, generalization to hadrons, models based on SU(2), bigger groups, possible unification of the strong interaction, another unification scheme, and spontaneous breakdown as a consequence of radiative corrections are given. (JFP)

27202 (CONF-720923-P4, pp 1-40) ELECTRON-POSITRON INTERACTIONS. Silvestrini, V. (CNEN, Frascati, Italy). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 4.

The discussion of electron-positron interactions and the electromagnetic structure of hadrons in the time-like region covers the validity of the underlying hypothesis, proton, pion, and kaon form factors, and multihadron production. (JFP)

27203 (CONF-720923-P4, pp 119-155) LIGHT CONE AND SHORT DISTANCE SINGULARITIES. Frishman, Y. (Standard Linear Accelerator Center, CA). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 4.

The treatment of the light cone and short distance singularities includes deep inelastic electron-nucleon scattering, light-cone expansions of operator products, the Fritzsch-Gell-Mann algebra, total annihilation $e^+e^- \rightarrow$ all and $\pi^0 \rightarrow 2\gamma$, single-particle inclusive e^+e^- annihilation, and other problems and approaches. (JFP)

27204 (JINR-P1-7557) DEEP INELASTIC LEPTON-PROTON SCATTERING AND μ-e UNIVERSALITY. Bilen'kaya, S. I.; Kazarinov, Yu. M.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 8p. (In Russian). INIS.

With the purpose of confirming μ-e universality a combined analysis is carried out of data on deep inelastic e-p and μ-p scattering. It is shown that these data are compatible if the cross sections of μ-p scattering are renormalized. The existing difference in cross sections of deep inelastic μ-p and e-p scattering apparently has to do with systematic errors and does not indicate a deviation from μ-e universality. (tr-SJR)

27205 (KFKI-75-9) BOUNDARIES OF APPLICABILITY OF OPTICAL THEOREM. Normalizing of the Scattering Functions. Strommer, R. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

The extinction cross section of particles illuminated by a light beam may sometimes be larger by an order of magnitude than the scattering cross section, mainly in the lower part of the size scale, the so-called aerosol particle size range (i.e., of about 0.1 to 5 μ in diameter), even for real refractive indices; this may appear paradoxical. It results, however, from the mathematical approach which is rarely emphasized in the literature. (auth)

27206 (LNF-73-60) QUARK MODEL PREDICTIONS FOR RADIATIVE DECAYS OF MESONS. Bramon, A.; Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 9 Oct 1973. 11p. INIS.

From simple quark model arguments and assuming a quadratic $\eta-\eta'$ mixing the radiative decays of the vector and pseudoscalar mesons are predicted, in good agreement with experiments. The

results strongly favor the new determination of the $\eta \to \gamma\gamma$ partial width. (auth)

27207 (LNF-73-61) FINITE DISPERSION RELATIONS APPROACH TO $\eta \to \pi^+\pi^-\gamma$ DECAY. Bramon, A.; Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 11 Oct 1973. 8p. INIS.

Finite dispersion relations are used to obtain $\Gamma(\eta \to \pi^+\pi^-\gamma) \simeq (41 \pm 16)$ eV. Through the known branching ratio $(\eta \to \pi^+\pi^-\gamma)/(\eta \to \gamma\gamma)$ are deduced $\Gamma(\eta \to \gamma\gamma) \simeq 310 \pm 120$ eV, in good agreement with the new determination of the $\eta \to \gamma\gamma$ partial width. (auth)

27208 (N-74-30144) COMPTON SCATTERING INDUCED BY RELATIVISTIC ELECTRONS. Chelkov, Yu. P.; Charugin, V. M. (AN SSSR, Moscow). Jul 1974. Translated from pp 7-21 of PR-144. (NASA-TT-F-15765). 16p. NTIS $4.00.

A study is made of induced Compton scattering by relativistic electrons as a process playing a role in high luminosity cosmic sources, and of the influence of such scattering on the radiation spectrum and energy losses of electrons. Consideration is confined to isotropic radiation and electron distribution and to the classic Thompson approximation. (auth)

27209 ABSENCE OF HIGHER-ORDER CORRECTIONS TO LOW-ENERGY THEOREMS IN NON-ABELIAN GAUGE THEORIES. Lee, S. Y.; Rawls, J. M. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). Nucl. Phys., B; 84: No. 1, 253-259(6 Jan 1975).

Using the renormalization group approach, a new proof is presented for the absence of higher-order corrections to the low-energy theorem for the matrix element of the divergence of the axial-vector current between the vacuum and two-photon states in spontaneously broken gauge theories. (auth)

27210 NEUTRAL CURRENT CROSS SECTIONS IN THE DEEP INELASTIC REGION. Herbert, J. M. (Kent Univ., Canterbury (UK)). Nucl. Phys., B; 84: No. 1, 93-108(6 Jan 1975).

By considering equal-time commutation relations in the quark model, sum rules are derived for the weak neutral structure functions in the deep inelastic region. By using electroproduction data neutral current cross sections can then be calculated in different gauge models. (auth)

27211 MOMENTUM DISTRIBUTION OF PARTONS IN DEEP INELASTIC LEPTOPRODUCTION. Svensson, B. E. Y.; Uschersohn, I. (Lund Univ. (Sweden). Institutionen foer Teoretisk Fysik med Mekanik). Phys. Lett., B; 53: No. 3, 277-279(9 Dec 1974).

The momentum distribution of partons in a nucleon as seen in deep inelastic leptoproduction is calculated using merely kinematic arguments. The rapidity distribution of the partons has a finite extension fixed by the energy of the final hadronic state. That parton which reacts is shown to remain inside the original rapidity distribution also after interaction. (auth)

27212 IMPLICATIONS OF ANOMALOUS LEPTON HADRON INTERACTIONS. Soni, A. (State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics). Phys. Lett., B; 53: No. 3, 280-284(9 Dec 1974).

A model is discussed for anomalous lepton hadron interactions which encompasses the phenomenological constraints from $\pi^0 \to e^-e^+, e^+e^- \to$ hadrons and deep inelastic ep scattering at SLAC. Its implications to $pp \to l^+l^-H$ and other reactions are investigated. (auth)

27213 VIOLATION OF SCALING IN ANNIHILATION AND ELECTROPRODUCTION. Nieh, H. T. (State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics). Phys. Lett., B; 53: No. 4, 344-346(23 Dec 1974).

It is speculated that there may be large violation of scaling in electroproduction, in the kinematic region of large ω. It reflects the large violation of scaling in e^+e^- annihilation. (auth)

27214 AN ALTERNATIVE FOR SENILE SCALING IN DEEP INELASTIC ANNIHILATION. Gensini, P. (Lecce Univ. (Italy). Istituto di Fisica). Phys. Lett., B; 53: No. 4, 362-364(23 Dec 1974).

DIA is studied in the frame of a simple EVMD model, yielding precocious scaling for DIS, together with good predictions for photoabsorption and vector meson photoproduction cross sections; the validity of the reciprocity relations is assumed, and in this model both senile scaling and large DIA cross sections emerge as consequences of strong mixing between the wide, overlapping vector meson levels in the high mass continuum. (auth)

27215 ELECTROPRODUCTION AND ANNIHILATION SCALING LAWS IN A DUAL MODEL. Amati, D.; Ellis, S. D.; Weis, J. H. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 84: No. 1, 141-177(6 Jan 1975).

Scaling laws for large virtual photon mass (q^2) in electroproduction and annihilation are studied in the framework of a simple planar dual model. As has recently been conjectured, it is found that the scaling behavior depends on the number of space-time dimensions spanned by large momenta. In particular, for a certain range of parameters in the model, it is found that the annihilation cross section is dominated by the one-dimensional configuration and increases with q^2 relative to its canonical behavior while the electroproduction total cross section is dominated by the two-dimensional configuration and has the canonical Bjorken scaling behavior. In general the scaling laws and therefore the structure of events in the model are distinctly different from the conventional parton model. The problem of consistency of planar dual tree diagrams with unitarity sum rules is discussed. (auth)

27216 BREMSSTRAHLUNG PROCESS IN THE PRESENCE OF INTENSE LASER BEAM AND STRONG COULOMB FIELD. Mohan, M. (Delhi Univ. (India). Dept. of Physics and Astrophysics). Phys. Lett., A; 50: No. 4, 283-284(11 Dec 1974).

The differential cross-section for the multiphoton bremsstrahlung process in the combined laser plus strong Coulomb field is evaluated. (auth)

27217 MULTIPOLE ANALYSIS OF π^+ AND π^0 PHOTOPRODUCTION FROM THRESHOLD TO E_γ = 330 MEV. Nigro, M. (Padua Univ. (Italy). Istituto di Fisica); Spillantini, P.; Valente, V. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Nucl. Phys., B; 84: No. 1, 201-220(6 Jan 1975).

Results of an energy independent multipole analysis of π^+ and π^0 photoproduction on protons are presented for photon energies between 160 and 330 MeV. Each isospin part of the $1 \leq 1$ amplitudes was parametrized; the $1 \geq 2$ amplitudes were approximated by the Born terms. Unambiguous solutions for all the multipoles in the whole range of E_γ were obtained. The continuity of the solutions as functions of the energy is very good. (auth)

27218 ABSORPTIVE CORRECTION TO PION EXCHANGE AS FUNCTION OF THE EXTERNAL MASS. Vanryckeghem, L. G. F. (Oxford Univ. (UK). Dept. of Theoretical Physics). Phys. Lett., B; 53: No. 3, 272-276(9 Dec 1974).

$\pi^\pm n$ electroproduction data are used to study the dependence of the absorptive correction to pion exchange on the external mass. A strong increase of the absorption is found as the photon becomes more space-like. It is argued that this increase is incompatible with present-day Regge absorption models. (auth)

27219 SOME BACKGROUND PROCESSES FOR EXPERIMENTS ON HADRON ANNIHILATION PRODUCTION IN e^+e^- COLLIDING BEAMS. Ginzburg, I. F.; Meledin, G. V.; Serbo, V. G. (AN SSSR, Novosibirsk. Inst. Matematiki). Phys. Lett., B; 53: No. 3, 263-268(9 Dec 1974).

Simple estimations for contributions of the background processes $e^+e^- \to \gamma h$ (hadrons), $e^+e^- \to e^+e^-h$ and radiative corrections to cross sections as well as the energy losses for experiments like CEA–SPEAR have been obtained. The corresponding corrections are on the order of 5–10%. Taking account of these corrections may help in resolving "the energy crisis." (auth)

27220 ELECTROPRODUCTION OF HIGHER SPIN RESONANCES WITHIN A GENERALIZED JOOS–WEINBERG FORMALISM. Eeg, J. O. (Univ. of Oslo). Phys. Norv.; 7: No. 3, 131-143(1974).

Nonquadrate generalized Joos–Weinberg matrices are constructed and electromagnetic currents for transitions from spin s to spin s' are given. Form factors are inserted phenomenologically. Matrix operators for different multipole transitions are also presented. Comparisons with other formulations are carried out. (auth)

27221 RADIATION OF A NEUTRAL FERMION WITH ELECTRIC AND MAGNETIC MOMENTS IN CONSTANT AND UNIFORM EXTERNAL ELECTROMAGNETIC FIELDS. Bagrov, V. G.; Bozrikov, P. V.; Gitman, D. M.; Klimenko, Yu. I.; Khudomyasov, A. I. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 150-151(1974). (In Russian).

The radiation of a neutron with both magnetic and electric moments moving in constant and uniform fields was calculated. Expressions were derived for the angular distribution of the radiation and its polarization. The degree of linear polarization depends on the presence of an electric moment in the neutron. The radiation of a stationary neutron is determined not only by magnetic but by electric fields. Therefore the linear polarization of the radiation examined can give information on the electric moment of the neutron. (JSR)

27222 ELECTRON IN CONSTANT CROSSED ELECTROMAGNETIC FIELDS AND A PLANE WAVE FIELD. Bagrov, V. G.;

Gitman, D. M.; Lavrov, P. M. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 68-74(1974). (In Russian).

A precise solution was given for the Dirac equation for an electron interacting with constant uniform orthogonal magnetic and electric fields (E = H) and with a field of plane waves being propagated in a direction perpendicular to E and H. In this field the plane waves were examined either as classical or quantized or as a field of waves consisting of classical and quantized particles. (tr-auth)

27223 CREATION OF TWO PAIRS OF FERMIONS DUE TO ANNIHILATION OF TWO POLARIZED FERMIONS. Morozov, D. F. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 88-91(1974). (In Russian).

The polarization contribution to the differential (according to the invariant mass of the pair being created and the angle) cross section for the creation of two pairs of fermions during the annihilation of polarized fermion pairs was found by a method proposed by Baier and Khoze. Angular integration was done for cases of longitudinal and transverse polarization. The tensor contraction was found without calculation of the tensors themselves using a method proposed by Morozov. (tr-auth)

27224 FERMION WITH ANOMALOUS MOMENT IN A FIELD OF QUANTIZED PLANE WAVE. Bagrov, V. G.; Bozrikov, P. V.; Gitman, D. M. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 129-132(1974). (In Russian).

The movement of an electron in a quantized field of plane waves was previously studied under the assumption that the electromagnetic field was not considered as an external given force but was itself part of the quantum mechanical system. This same problem is examined but with consideration of an anomalous magnetic moment in the electron. The solution showed that the spin number enters into the function of photon variables. This indicates that the presence of an anomalous magnetic moment leads to a correlation between the electron spin and the quasiparticles of the field of plane waves. However the energy of the quasiparticles do not depend on the polarization of the electron. (JSR)

27225 ELECTRON IN A QUANTIZED FIELD OF PLANE WAVES AND IN A CLASSICAL FIELD WITH REDMOND'S CONFIGURATION. Bagrov, V. G.; Gitman, D. M.; Lavrov, P. M. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 47-51(1974). (In Russian).

The Dirac equation for an electron interacting both with a quantized field of plane waves with classical electromagnetic fields consisting of plane waves and constant homogeneous magnetic field parallel to the direction of production of both axes was solved precisely. (tr-auth)

27226 ELECTRON INTERACTION IN AN OSCILLATORY FIELD. Lozanskii, E. D.; Firsov, O. B. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 52-54(1974). (In Russian).

The case of a precise solution of the Schroedinger equation for systems of two interacting electrons existing in a spherical oscillating field was examined. On the basis of the solution obtained an evaluation of the precision of the Hartree–Fock method was made. (tr-auth)

27227 INDUCED RADIATION OF ELECTRONS MOVING IN UNIFORM MAGNETIC AND ELECTRIC FIELDS WITH RHOMBIC SYMMETRY. Dement'ev, A. S.; Pavlenko, Yu. G. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 61-63(1974). (In Russian).

By the methods of quantum mechanics it was shown that nonrelativistic electrons moving in these fields are sources of induced radiation in the uhf region. (tr-auth)

27228 DECONVOLUTION IN COMPTON PROFILE MEASUREMENTS. Paatero, P.; Manninen, S.; Paakkari, T. (Univ. of Helsinki). Phil. Mag.; 30: No. 6, 1281-1294(Dec 1974).

Various deconvolution schemes are discussed in terms of harmonic analysis and then considered in relation to line profile measurements. A new practical solution of the method of least squares together with a tail stripping procedure and a realistic error estimation are presented. The use of a residual instrumental function in comparing experiments with a theory is suggested. The method is applied to γ-ray Compton profile measurements. (auth)

27229 SUPERBOUND ELECTRONS. Okun, L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Comments Nucl. Particle Phys.; 6: No. 1, 25-27(Feb 1974).

The mathematical description of a superbound electron is discussed and its properties are examined. It is thought that in time laboratory experimental studies may be possible on superbound electrons, and it is also possible that conditions for the production of such electrons may be found in astrophysical objects. Even if this is not so, superbound electrons are an interesting subject for the theorist. Their physics will probably find applications in connection with models of elementary particles and in the theory of nuclear matter. 7 references. (UK)

27230 HIGH-ENERGY LIMIT VERSUS INFINITE-MASS LIMIT IN THE COULOMB PROBLEM. Dittrich, W. (Univ., Tuebingen, Ger.). J. Phys., A (London); 7: No. 18, 2273-2283(11 Dec 1974).

Relativistic eikonal physics is applied to Coulomb scattering and bound states. It is shown that the eikonal approximation can accommodate the impact factor result as well as the non-relativistic Balmer spectrum. It is argued that relativistic corrections are outside this realm of approximation. This will be confirmed by eikonalizing the high-energy scattering amplitude of an electron in a static Coulomb field which is generated by a proton. (auth)

27231 J-MATRIX METHOD: EXTENSIONS TO ARBITRARY ANGULAR MOMENTUM AND TO COULOMB SCATTERING. Yamani, H. A. (Harvard Univ., Cambridge, MA). J. Math. Phys. (N. Y.); 16: No. 2, 410-420(Feb 1975).

The J-matrix method introduced previously for s-wave scattering is extended to treat the lth partial wave kinetic energy and Coulomb Hamiltonians within the context of square integrable (L^2), Laguerre (Slater), and oscillator (Gaussian) basis sets. The determination of the expansion coefficients of the continuum eigenfunctions in terms of the L^2 basis set is shown to be equivalent to the solution of a linear second order differential equation with appropriate boundary conditions, and complete solutions are presented. Physical scattering problems are approximated by a well defined model which is then solved exactly. In this manner, the generalization presented treats the scattering of particles by neutral and charged systems. The appropriate formalism for treating many channel problems where target states of differing angular momentum are coupled is spelled out in detail. The method involves the evaluation of only L^3 matrix elements and finite matrix operations, yielding elastic and inelastic scattering information over a continuous range of energies. (auth)

27232 DISPROOF OF A CONJECTURE OF D. MUHLERIN AND I. ZINNES. Dollard, J. D. (Univ. of Texas, Austin). J. Math. Phys. (N. Y.); 16: No. 2, 391-393(Feb 1975).

It is shown that the operator $U_C^{(2)}(t)$ defined by Muhlerin and Zinnes in their account of Coulomb potential scattering theory is not an isometry when the Coulomb potential is weak enough. It is opined that for this reason their account of Coulomb potential scattering theory does not have a straightforward physical interpretation. (auth)

27233 DYNAMICAL ORIGIN OF THE RIGHT-SIGNATURE FIXED POLE IN COMPTON SCATTERING. Close, F. E.; Rubinstein, H. R. (European Organization for Nuclear Research, Geneva (Switzerland)); Ferro Fontan, C. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nucl. Phys., B; 85: No. 2, 461-470(27 Jan 1975).

A new sum rule is found for the residue of the J = 0 fixed pole in Compton scattering. The sum rule applies to any target and links the residue to a calculable set of contributions from the resonance region. Proton, neutron, deuteron and pion targets are discussed, and the possibility of discriminating from previous models. The relationship with the parton model is noted and the feasibility of measuring pion photoabsorption cross sections is discussed. (auth)

27234 HYDRODYNAMICAL MODEL OF ELECTRON–POSITRON ANNIHILATION INTO HADRONS. Morley, P. D. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). Nucl. Phys., B; 85: No. 2, 471-491(27 Jan 1975).

Landau's hydrodynamical model of multiparticle production is formulated for $e^+e^- \rightarrow$ hadrons at center-of-momentum energies 10 GeV and higher. An analytical solution to the problem of spherical expansion of a relativistic fluid is presented. When hadrons condense out at the last stage of expansion, fluid thermal motion is taken into account. Predictions for multiplicities, average secondary energies and inclusive single particle distributions for various secondary hadrons are derived; these results are then compared with other models. Finally, the internal consistency of the model is investigated. (auth)

27235 ω DEPENDENCE OF EXCLUSIVE HADRONIC FINAL STATES IN LEPTON–HADRON SCATTERING. Cleymans, J.; Close, F. E. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 85: No. 2, 429-441 (27 Jan 1975).

A framework is presented for studying the ω dependence of exclusive hadronic final states in lepton–hadron scattering (ω being Bjorken's scaling variable $2M\nu/Q^2$). This is used for the analysis of $K\Sigma$, $K\Lambda$, πN and $\pi\Delta$ final states. (auth)

27236 A MULTIPOLE ANALYSIS OF PION PHOTOPRODUCTION IN THE FIRST RESONANCE REGION. Berends, F. A. (Rijksuniversiteit Leiden (Netherlands). Instituut Lorentz voor Theoretische Natuurkunde); Donnachie, A. (Manchester Univ. (UK). Dept. of Physics). Nucl. Phys., B; 84: No. 2, 342-361 (13 Jan 1975).

An energy-independent multipole analysis of pion photoproduction in the first resonance region was performed in which special care was taken in the selection and normalization of the data. The results obtained are a significant improvement on those of earlier analyses. Three features are of particular interest: a zero in the $E_{1+}^{\frac{3}{2}}$ multipole at resonance; a smooth $M_1^{\frac{3}{2}}$-multipole showing the onset of the $P_{11}(1470)$ resonance; and evidence for the position of the Δ^+ resonance being different from those of the Δ^{++} and Δ^0 resonances. A comparison is made with the recent energy-dependent analyses, indicating agreement in the gross features of the multipoles but showing differences in essential details. (auth)

27237 RECENT HIGH ENERGY ELECTRON, MUON, AND NEUTRINO EXPERIMENTS. Barish, B. C. (California Inst. of Tech., Pasadena). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 1-21(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A survey of recent results on deep inelastic inclusive reaction with beams of electrons, muons, and neutrinos is presented. Tests of scaling, the spin of the constituents, and the relation between electron/muon and neutrino scattering is discussed. (auth)

27238 e^+e^- REACTIONS: THEORY. Greenberg, O. W. (Univ. of Maryland, College Park). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 409-436(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Some theoretical approaches to electron-positron annihilation to hadrons are reviewed. (auth)

27239 STATE OF THE ART—GAUGE THEORIES. Georgi, H. (Harvard Univ., Cambridge, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 575-582(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). Se CONF-740933-.

The discussion of the state of the art in gauge theories includes the class of unified theories of the weak, electromagnetic, and strong interactions. By this is meant gauge models describing the weak, electromagnetic, and strong interactions in terms of a single coupling constant, so that the gauge groups of the world is either simple or a product of isomorphic simple factors. (JFP)

27240 SOME EXPERIMENTAL TESTS OF ASYMPTOTIC FREEDOM. Wilczek, F. (Princeton Univ., NJ). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 596-603(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A new and precise formalism for deriving behavior of the time-like vacuum polarization from behavior on the space-like side is presented. It is then applied to e^+e^- annihilation. The qualitative structure of deviations from Bjorken scaling is high energy neutrino reactions in asymptotically free theories is described. (auth)

27241 LANDAU'S HYDRODYNAMIC MODEL OF PARTICLE PRODUCTION AND ELECTRON—POSITRON ANNIHILATION INTO HADRONS. Cooper, F.; Frye, G. (Belfer Graduate School of Science, Yeshiva University, New York, New York 10033); Schonberg, E. Phys. Rev. D 11: No. 1, 192-213 (1 Jan 1975).

The hydrodynamic model of Landau is formulated in very general terms and applied to the determination of average energy of secondaries, and single—particle inclusive distributions of secondaries. Attention is focused on the relationship between various dynamical assumptions and the equation of state assumed for the fluid motion. In the regimes of scaling and approximate scaling, we solve analytically the hydrodynamic motion of the fluid for both $pp \to \pi + X$ and $e^+ + e^- \to \pi + X$. For the annihilation process we solve the hydrodynamic equations numerically and discuss the validity of the scaling approximations. Explicit comparison is made between two dynamical models, the ultrarelativistic model (ideal—gas model) and the hadronic spectrum model. (auth)

27242 INCLUSIVE PROCESSES AT HIGH TRANSVERSE MOMENTUM AND THE MODIFIED KUTI—WEISSKOPF MODEL. Pakvasa, S.; Parashar, D.; Tuan, S.F. (Department of Physics and Astronomy, University of Hawaii, Honolulu, Hawaii 96822). Phys. Rev. D 11: No. 1, 214-218 (1 Jan 1975).

The modified Kuti—Weisskopf model is applied to some additional processes like $\gamma + N \to \gamma +$ anything, $\gamma + N \to N +$ anything, $N + N \to \gamma +$ anything, and $N + N \to W +$ anything at high transverse momentum using the formalism of Berman, Bjorken, and Kogut. (auth)

27243 RELATION BETWEEN e^+e^- ANNIHILATION INTO HADRONS AND HADRONIC μ—PAIR PRODUCTION. Goldman, T.; Vinciarelli, P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 11: No. 1, 219-222 (1 Jan 1975).

We propose a relation between the dependence of the differential cross section for $pp \to \mu\mu + X$ on the di—muon mass $\sqrt{Q^2}$ and the dependence of the total cross section for $e^+e^- \to$ hadrons on the total c.m. energy $\sqrt{s}$ in the form of a factorization rule. This rule is justified as an extension to the case of a more general di—lepton—di—parton vertex of a factorization rule which is trivially satisfied in the Drell—Yan parton picture of $pp \to \mu\mu + X$ with one—photon mediation of that vertex. The available data from SPEAR and BNL, *including the scale—breaking signal*, are consistent with this relation. More stringent tests of the relation at higher energies are also considered. (auth)

27244 IS HADRONIC MATTER A SUPERFLUID?. Chapline, G.F. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. D 11: No. 1, 156-158 (1 Jan 1975).

The scaling behavior of deep—inelastic electron—proton scattering can be simply explained if it is assumed that the matter comprising a proton is a superfluid. This interpretation shows clearly why scaling behavior occurs at relatively low energies but leaves open the question of scaling at very high energies. (auth)

27245 MULTIPLICITY MEASUREMENTS IN e^+e^- COLLIDING—BEAM EXPERIMENTS. Grammer, G. Jr.; Smith, J. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794). Phys. Rev. D 11: No. 1, 223-225 (1 Jan 1975).

We discuss the sensitivity of the multiplicity measurements in e^+e^- colliding—beam experiments to small background effects, such as radiative corrections and two—photon processes. (auth)

27246 STATISTICAL SCALING IN INCLUSIVE γp, e^-p, AND e^+e^- REACTIONS. Ta—chung, M.; Moeller, E. (Institut für Theoretische Physik der Freien Universität Berlin, Berlin, Germany). Phys. Rev. D 11: No. 1, 36-42 (1 Jan 1975).

High—energy inclusive γp, e^-p, and e^+e^- reactions are discussed in connection with the modified Fermi model. Evidence for statistical scaling in these processes is presented. (auth)

27247 DEEP—INELASTIC eN AND νN SCATTERING: A UNIFIED DESCRIPTION VIA DUAL REGGE POLES AND SU(3). Duke, D.W. (Ames Laboratory—USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. D 11: No. 1, 43-48 (1 Jan 1975).

The deep—inelastic scattering of electrons and neutrinos off nucleons is studied phenomenologically by means of a model that describes the scattering of weak and electromagnetic currents off nucleons. It is found that one may impose the constraints of Regge behavior, duality, SU(3) symmetry, and current algebra in a model for the structure functions and obtain a very accurate and economical description of the data. This approach demonstrates a remarkable resemblance between the strong interactions of hadrons and their weak and electromagnetic interactions. (auth)

27248 WHAT IS THE ASYMPTOTIC LIMIT OF $\sigma(e^+ + e^- \to \text{hadrons})/\sigma(e^+ + e^- \to \mu^+ + \mu^-)$, IF ANY? Terazawa, H. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 11: No. 1, 49-57 (1 Jan 1975).

More extensive discussion is given on the previously derived relation, $R \cong 16\pi^2/f_\rho^2 = 5.7 \pm 0.9$, where R is the asymptotic limit of the ratio $R(q^2) = \sigma(e^+ + e^- \to \text{hadrons})/\sigma(e^+ + e^- \to \mu^+ + \mu^-)$ and f_ρ is the γ—ρ coupling constant. It contains (1) a detailed derivation of the relation, (2) a rough estimate of possible corrections due to the extrapolation and higher vector-meson resonances, (3) the plausibility of the conjecture of Freund and Nandi, (4) some other ways of estimating R, and (5) the compatibility of the relation and a few other similar relations. The ratio $R(q^2)$, whose increase at $q^2 = 9$–25 GeV^2 has recently been observed in the CEA and SLAC (SPEAR) $e^+ - e^-$ colliding—beam experiments, is expected not to increase much at higher energies. (auth)

27249 SECONDARY REACTIONS IN ELECTRON—POSITRON (ELECTRON) COLLISIONS. Chen, M.; Zerwas, P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 11: No. 1, 58-67 (1 Jan 1975).

Secondary photon, electron, and positron beams are produced in colliding lepton—lepton rings. They induce inelastic electron Compton scattering and electron—photon scattering processes via photon—photon

annihilation; likewise hard–photon bremsstrahlung belongs to this class of reactions. We study in detail the cross sections of these processes for high–energy lepton beams and discuss their physical significance. (auth)

27250 TRANSITION RADIATION FROM ULTRARELATIVISTIC PARTICLES. Durand, L. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. D 11: No. 1, 89-105 (1 Jan 1975).

In the present paper, we give a simple derivation of the spectrum and angular distribution of the transition radiation emitted by ultrarelativistic particles which pass through dielectric foils. The approximations appropriate for high–frequency radiation in the ultrarelativistic limit are made at the beginning. The calculations are consequently much simpler than standard calculations, and our results, some of which are apparently new, are relatively simple and easy to interpret. The primary emphasis in the development is on conditions likely to be encountered in the application of transition radiation detectors in high–energy physics. (auth)

27251 DEEP–INELASTIC ELECTROPRODUCTION AND THE Q^2 BEHAVIOR OF THE $J = 0$ FIXED POLE. Dominguez, C.A.; Moreno, H. (Departamento de Física, Centro de Investigación y de Estudios Avanzados del Instituto Politecnico Nacional, Apartado Postal 14–740, Mexico 14, D.F.). Phys. Rev. D 11: No. 1, 119-128 (1 Jan 1975).

We construct a resonance model for deep–inelastic electroproduction on nucleons in which νW_2 shows explicit Regge behavior. The extrapolation of the full expression for νW_2 to the low–ω' and fixed–Q^2 region provides a rather accurate average to the resonances in the sense of certain finite–energy sum rules. The residues of the proton and neutron $J = 0$ fixed poles are computed as functions of Q^2 turning out to be nonpolynomial, and as $Q^2 \to 0$ they approach the well–known photoproduction values. The neutron residue never becomes greater than zero, while the proton residue changes sign at $Q^2 = 0.08$ GeV^2. We finally obtain an interesting expression for the limiting value of the excitation vertex radius, i.e., $\langle r^2 \rangle = (3/4\pi^2\alpha)\,[\sigma_T \nu\, N(\infty) / F_2(\infty)]$. (auth)

27252 NONLINEAR GRAVITATIONAL EFFECTS AND MAGNETIC MONOPOLES. Parker, L. (Department of Physics, University of Wisconsin–Milwaukee, Milwaukee, Wisconsin 53201). Phys. Rev. Lett. 34: No. 7, 412-415 (17 Feb 1975).

The Einstein–Maxwell equations for systems of particles possessing electric and magnetic charge are considered. The consequences of the linear and nonlinear theories are contrasted, by considering a known class of exact solutions. In particular, for these systems of dually charged particles, angular momentum quantization leads to charge quantization only in the linear theory. Furthermore, if "strut" singularities are excluded, then isolated magnetic monopoles are forbidden in these solutions by nonlinear gravitational effects. (auth)

27253 RIGOROUS RESULTS CONCERNING LIGHT CONE DOMINANCE IN DEEP INELASTIC LEPTON–HADRON SCATTERING. Magg, M. (Technische Hochschule Aachen (F. R. Germany). Inst. fuer Theoretische Physik). Commun. Math. Phys.; 38: No. 3, 225-240(Nov 1974).

We consider a class of distributions appearing in electroproduction and satisfying a Jost–Lehmann–Dyson representation. We then prove without further assumptions that only their singularity structure near the light cone is relevant for the behavior of their Fourier transform in the Bjorken limit. Furthermore, we study the ambiguity in this singularity structure introduced by the fact that scaling is known only in the space–like region of momentum space. (auth)

27254 RADIATIVE CORRECTIONS FOR HIGH ENERGY COINCIDENCE EXPERIMENTS. Etim-Etim (Laboratori Nazionali, Frascati, Italy); La Rotonda, L. Acta Phys. Austr.; 38: No. 4, 313-320(1973).

A simple method of calculating radiative corrections is proposed which avoids previous problems, but which possesses a powerful mechanism of cancellation between specific groups of terms in the end formula thereby ensuring a smooth extrapolation from high to low energies. The process considered is of the general type e + p → e + B + anything, where A and B are hadrons. These processes possess a property of scaling in the limit of high energy and momentum transfers, the deep inelastic limit. (JFP)

27255 STUDY OF SCALING IN THE INCLUSIVE PION DISTRIBUTIONS IN ELECTROPRODUCTION. Pal, B. K. (Imperial Coll. of Science and Tech., London). Acta Phys. Austr.; 38: No. 4, 382-385(1973).

The virtual photoproduction cross sections are studied for the process e + p → e + π^+ + anything as a function of p_T^2. The results suggest a simple scaling behavior. (auth)

27256 $\gamma d \to \pi^0 d$ REACTION ASYMMETRY IN THE IMPULSE APPROXIMATION AT THE PHOTON ENERGIES UP TO 800 MeV. Boldyshev, V. F.; Kolesnikov, L. Ya.; Naisteter, S. I. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 20: No. 6, 1162-1167 (Dec 1974). (In Russian).

The differential cross sections and the asymmetry are calculated for the $\gamma d \to \pi^0 d$ reaction with the S and D states in the deuteron wave function taken into account. Photon energies of 180 to 800 MeV and pion angles from 0 to 180° in c.m.s. were considered. Several multipole analyses of the pion photoproduction on nucleons were used in applying the impulse approximation. (4 figures) (auth)

27257 SINGLE π^+ ELECTROPRODUCTION AND THE VECTO-MESON DOMINANCE MODEL. Pal, B. K. (International Centre for Theoretical Physics, Trieste, Italy). Acta Phys. Austr.; 38: No. 4, 321-326(1973).

A complex Regge pole model is used to predict the longitudinal cross section of the single-pion electroproduction. Reasonable agreement is found for all parts of the cross section. (auth)

27258 QUANTUM TRANSITIONS OF ELECTRONS IN SUPER-STRONG MAGNETIC FIELDS. Sokolov, A. A.; Zhukovskii, V. Ch.; Nikitina, N. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 5, 548-552(1974). (In Russian).

The probability for the emission of hard γ quanta during the transition of relativistic electrons to ground level or close to it in a magnetic field $H \sim H_0 = m^2c^3/e\hbar = 4.1 \times 10^{13}$ Oe was obtained. For the reverse transition with this level, the cross section for the photoexcitation of electrons was calculated, and it was shown that it is maximum at $H = 2H_0$. (tr-auth)

27259 EXCHANGE CURRENTS IN ELECTROMAGNETIC AND WEAK NUCLEAR INTERACTIONS, LOW ENERGY THEOREMS. Guiasu, I. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 4, 445-465(1974). (In Rumanian).

The definition of the nuclear exchange currents are discussed in connection with the nonrelativistic Schrodinger equation for a system of nucleons in an external field. Low energy theorems and their application in the two-body matrix elements of nuclear currents calculations are presented. (auth)

27260 FORMATION OF ELECTRON–POSITRON PAIRS DURING THE INTERACTION OF LOW ENERGY π MESONS WITH NUCLEONS. Radutskii, G. M.; Serdyutskii, V. A. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 150-151(1974). (In Russian).

The electron production amplitudes with hard pions, previously obtained in the model of the algebra of currents, was used to calculate the dependence of the internal conversion coefficient on the square of momentum transfer. (JSR)

27261 BREMSSTRAHLUNG OF ELECTRONS WITH ANOMALOUS MOMENTS IN A FIELD OF A PLANE ELECTROMAGNETIC WAVE. Klimenko, Yu. I.; Kulish, V. V.; Khudomyasov, A. I. (Moscow Wood-Technical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 142-143(1974). (In Russian).

The induced bremsstrahlung effect of an electron having not only an anomalous magnetic moment, but also an anomalous electrical moment, was examined. (JSR)

27262 POLARIZATION EFFECTS IN THE THEORY OF TRANSITION RADIATION. Kukanov, A. B. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 98-103(1974). (In Russian).

The problem of the transition radiation from current-carrying charged bunches intersecting perpendicularly a plane-parallel ferrodielectric foil was solved. Expressions were obtained, by the method of stationary phases, for the radiation fields through and on the foil and the radiation energy was calculated. The polarization effect was taken into consideration. It was shown that the radiation by the foil examined is completely elliptically polarized. The linear polarization of the radiation at large distances from the foil was confirmed. In nonrelativistic limits formulation for the radiation energy were analyzed for the case of very thin foils. (tr-auth)

27263 RADIATION FROM A NEUTRON MOVING IN CROSSED FIELDS IN THE MEDIUM. Dement'ev, A. S.; Pavlenko, Yu. G. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 34-38(1974). (In Russian).

The spontaneous radiation of an electromagnetic wave by a neutron moving in homogeneous crossed fields in the medium was studied by the methods of quantum electrodynamics. Expressions were obtained for the radiation strength of the two primary components of polarization. (tr-auth)

27264 PARTICLE DISTRIBUTIONS IN THE 10^{-2} TO 10^{12} eV ENERGY RANGE INITIATED BY HIGH ENERGY HADRONS IN DENSE MEDIA. Kimel, L. R.; Mokhov, N. V. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 17-23(1974). (In Russian).

A method was developed for the calculation of the distribution function of hadrons, muons, and γ quanta of an internuclear cascade in dense media. The HMALET program was formulated for the solution in plane and cylindrical geometry of the problem of transfer in the energy range from 10^{-2} to 10^{12} eV. The K meson component of nucleon-meson cascades was examined for the first time. The calculation results agree well with experimental data. (tr-auth)

27265 GENERALIZED VECTOR MESON DOMINANCE OF ELECTROMAGNETIC INTERACTIONS IN A RELATIVISTIC QUARK MODEL. Boehm, M. (Univ., Wuerzburg, Ger.); Joos, H.; Krammer, M. Acta Phys. Austr.; 38: No. 2, 123-129 (1973).

From a relativistic dynamical quark model one derives the electromagnetic properties of the vector mesons. In particular, one calculates the vector meson-current coupling constants γ_V for $\rho^0(765)$, $\rho'^0(1600)$, and the role of the radially excited vector mesons for $\sigma_{tot}(e^+e^-) \rightarrow$ hadrons is discussed. In this model the higher vector mesons, in the average, generate a "pointlike" cross section. (auth)

27266 WHY (e^+e^-) PHYSICS IS FASCINATING. Zichichi, A. (CERN, Geneva). Riv. Nuovo Cim.; 4: No. 4, 498-532(1974).

The results obtained by the Bologna-CERN-Frascati Collaboration during about three years of work at Frascati are reviewed and taken as a basis to show the impact of (e^+e^-) physics in understanding the laws of subnuclear phenomena. (auth)

27267 THEORETICAL STUDIES FOR HIGHER-ENERGY e^+e^- COLLISIONS. Gatto, R.; Preparata, G. (Univ., Rome). Riv. Nuovo Cim.; 4: No. 4, 445-497(1974).

Studies on e^+e^- annihilation at higher energies are summarized dealing especially with the general expectations one can draw at this moment for such processes, in particular as to the existence and feasibility of experiments susceptible of clean theoretical interpretation. Two-photon (Brodsky mechanism) versus one-photon production, annihilation via two photons, possible weak effects, expectations for one- and two-particle inclusive annihilation, and the senility of scaling. (JFP)

27268 GRAVITATION INDUCED ELECTROMAGNETIC FIELDS. Tiomno, J. Acta Phys. Austr.; 38: No. 2, 206-210(1973).

Maxwell's equations for axially symmetric stationary distribution of charges and currents in presence of the stationary gravitational field of rotating massive bodies (with the same axis of rotation) are examined for small electric charges and currents. The equations for the electric and magnetic field components in the local inertial frame are then written as Maxwell's equations in the static gravitational background of the same mass distribution at rest with real and "induced" (effective) electric and magnetic charges and currents. The induced fields which are the generalization to strong gravitational background of the Ehlers-Rindler effect are analyzed. (auth)

27269 MULTIPHOTON PROCESSES IN THE COMPTON SCATTERING AND INDUCED COMPTON SCATTERING IN A CONSTANT ELECTROMAGNETIC FIELD. Herrmann, J. (Univ., Jena, Ger.). Exp. Tech. Phys.; 22: No. 5, 387-391(1974). (In German).

Nonlinear effects (with respect to photon density) of Compton scattering and of induced Compton scattering in an external constant electromagnetic field, which are due to multi-photon absorption and emission, are discussed. The probabilities of these effects are calculated. (auth)

27270 EFFECT OF ANGULAR DISCRIMINATION OF X-RAY TRANSITION RADIATION ON THE EFFICIENCY OF PARTICLE SEPARATION. Gevorgyan, L. A.; Lorikyan, M. P.; Shikhlyarov, K. K. (Inst. of Physics, Erevan). Zh. Eksp. Teor. Fiz.; 68: No. 2, 400-404(Feb 1975). (In Russian).

Results are presented of measurements of the angular distributions of x-ray transition radiation generated in foam plastic by 2, 3, 4 or 4.6 GeV electrons. The results are compared with the theory. It is shown that angular discrimination results in a significant improvement of separation of ultrarelativistic particles. (auth)

27271 ELECTRON-POSITRON PAIR PRODUCTION IN VACUUM. Bagrov, V. G.; Gitman, D. M.; Shvartsman, Sh. M. (Tomsk Inst. of Automotive Systems Master Switch Radioelectronics, USSR). Zh. Eksp. Teor. Fiz.; 68: No. 2, 392-399(Feb 1975). (In Russian).

An electron-positron field interacting with an external electromagnetic field is examined. It is shown that the probability for pair production and the probability that vacuum remains vacuum can be expressed in terms of exact solutions of the Dirac equation for the field. As an example of application of the results the probability is found for pair production by a stationary electric field of finite time of action. The formulas yield, in particular, the effective time of pair production. (auth)

27272 INDUCED RADIATION OF FERMI PARTICLES IN THE FIELD OF TWO PLANE COLINEAR ELECTROMAGNETIC WAVES WITH ARBITRARY POLARIZATION. Klimenko, Yu. I.; Kulish, V. V.; Khudomyasov, A. I. (Moscow Wood-Technical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 12-18(1974). (In Russian).

The effect of the induced radiation of Fermi particles moving in the field of two plane monochromatic waves of arbitrary polarization, being propagated in one direction, was examined. Formulas were obtained for the probability and total strength of the particle radiation. The spin behavior in this process was studied. (tr-auth)

27273 MOTION OF NEUTRAL FERMIONS WITH ANOMALOUS MAGNETIC AND ELECTRIC MOMENTS IN EXTERNAL FIELDS. Klimenko, Yu. I. (Moscow Wood-Technical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 7-12(1974). (In Russian).

The covariant spin operator of Fermi particles having anomalous magnetic and electric moments and appearing in external constant fields was obtained. The behavior of the spin of the neutral Fermi particle in constant electric and magnetic field was investigated by means of the precise solution obtained for the Dirac equation. (tr-auth)

27274 ADIABATIC MOTION OF CHARGED PARTICLES IN A PLANE ELECTROMAGNETIC WAVE PROPAGATING ALONG A CONSTANT MAGNETIC FIELD WITH SLOWLY CHANGING VELOCITY. Davydovskii, V. Ya.; Ukolov, A. S. (Taganrog Radiotechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 79-83(1974). (In Russian).

Equations are derived and numerically evaluated for the movement of a charged particle in a wave when the wave velocity is slowly changing. The evaluation showed that the energy oscillation amplitude of the trapped charged particles can reach high values. This indicates that in the presence of a constant magnetic field even slow particles can be trapped by fast electromagnetic waves. (JSR)

27275 RADIATION FRICTION. Mavrychev, Yu. S. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 127-128(1974). (In Russian).

Two well known problems are connected with consideration of the radiation reaction in the equation of movement of charged particles: elimination of unacceptable solutions and elimination of the discrepancy of the radiated work energy of strong radiation friction. It is shown that a modified equation of motion, used for solution of the first problem, can be used for the solution of the second problem. (JSR)

27276 INDUCED SCATTERING OF LIGHT BY LIGHT IN A VACUUM. Dewar, R. L. (Australian National Univ., Canberra). Phys. Rev., A; 10: No. 6, 2107-2111(Dec 1974).

The energy scattered from three intense, circularly polarized laser beams into a fourth beam due to vacuum-polarization effects is calculated for general angles between the beams. A semiclassical WKB technique is used which allows an accurate treatment of the geometry of the interaction region. The effects of incoherence and optical phase errors are estimated. Both the center-of-momentum and tetrahedrally symmetric cases are examined explicitly, and the results indicate that light-light scattering may be observable using laser systems of the size needed for laser-fusion studies. (auth)

Weak

Refer also to abstracts 27438, 27446, and 27894.

27277 (CONF-720923-P2) PROCEEDINGS OF THE XVI INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS, CHICAGO-BATAVIA, ILLINOIS, SEPTEMBER 6-13, 1972. Volume 2. Parallel Sessions: Mostly Currents and Weak Interactions. Jackson, J. D.; Roberts, A.; Donaldson, R. (eds.). (Chicago Univ., Ill. (USA); National Accelerator Lab., Batavia, Ill. (USA)). 1972. 486p. Dep. NTIS $27.50.

Separate abstracts were prepared for the 31 papers presented. (JFP)

For abstracts of individual papers see: 27026–27031, 27041–27046, 27142, 27143, 27197–27201, 27278–27284, and 27841–27845.

27278 (CONF-720923-P2, pp 130-131) CONTINUATION FROM DEEP INELASTIC SCATTERING TO DEEP INELASTIC ANNIHILATION. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The relation which exists between deep inelastic scattering and deep inelastic annihilation is discussed. The degree of generality of the previous result that the appropriate correlation function of deep inelastic annihilation $\nu\bar{W}(q^2,\nu)$ scaled according to Bjorken ($\omega = q^2/2\nu$), $\nu\bar{W}(q^2,\nu) \to \bar{F}(\omega)$, where $\omega \geq 1$, and that $\bar{F}(\omega)$ was given by the analytic continuation for $\omega > 1$ of the analogous $F(\omega)$ of deep inelastic scattering is considered. (JFP)

27279 (CONF-720923-P2, pp 175-186) WEAK INTERACTIONS. I: Hyperon Decays. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The review of hyperon leptonic decays covers $\Lambda^0 \to pe\bar{\nu}$ decay, the Cabibbo fit to hyperon decays, $\Delta S = 0$ second-class currents, induced pseudotensor term in Λ^0 beta decay, measurement of the Ξ^- magnetic moment, and hyperon beams and experiments at BNL and CERN. (JFP)

27280 (CONF-720923-P2, pp 190-195) THEORETICAL CONSIDERATIONS ON NEUTRAL CURRENTS. Lee, B. W. (State Univ. of New York, Stony Brook). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The discussion of neutral currents in neutrino-induced interactions covers the effects of neutral-current interactions on purely leptonic and semi-leptonic processes, bounds on the parameter $x = \sin^2\theta_w$ implied by the existing data, and theoretical predictions on possible future experiments. (JFP)

27281 (CONF-720923-P2, pp 200-205) TWO-BODY AND QUASI-TWO-BODY REACTIONS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The discussion of charged currents in neutrino–nucleon interactions covers $\bar{\nu}p \to \mu^+\Lambda^0$, $\nu n \to \mu^- p$, and $\mu p \to \mu^-\Delta^{++} \to \mu^-\pi^+ p$ interactions. The invariant mass and energy distributions, total and differential cross sections, and density matrix elements are considered for these reactions. (JFP)

27282 (CONF-720923-P2, pp 209-237) WEAK INTERACTIONS. III: Meson Decays. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The review of weak interactions covers K_{l3} form factors, $K \to 2\pi$ decays, $K \to 3\pi$ and $\eta \to 3\pi$ decays, and the status of η_{+0}, η_{000}, and $\Delta Q/\Delta S$ in K_{l3} decays. (JFP)

27283 (CONF-720923-P2, pp 275-284) DISPERSION RELATIONS AND WEAK INTERACTIONS AT HIGH ENERGY. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The treatment of a dispersion approach to weak interactions at high energies includes asymptotic bounds on the total cross sections and higher order weak interactions at finite energy. The Pomeranchuk relation, the energy at which weak interactions become strong, model of strongly interacting W bosons, general form of the amplitude of weak interactions at low energy, dispersion sum rule for ln, dispersion sum rule for the Fermi constant G, weak interaction of colliding beams with energy of 10^2 to 10^3 GeV, long-range forces and weak interaction at high energies, asymptotic bound on the total cross section: $\sigma(s) < s^{\frac{1}{2}}$, two-particle exchange, and asymptotic bounds on the total cross section: $S^{-1} \leq \sigma(s) \leq s^0$ are covered. (JFP)

27284 (CONF-720923-P2, pp 307-319) HIGHER ORDER CALCULATIONS IN GAUGE MODELS OF WEAK INTERACTIONS. Primack, J. R. (Harvard Univ., Cambridge, MA). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

Higher-order calculations in gauge models of weak interactions are given which may be useful in guiding the construction of better models and in elucidating the physical consequences which follow from them. Static quantities, muon decay, and higher-order corrections to neutral current processes are considered. (JFP)

27285 (CONF-720923-P4, pp 157-188) WEAK INTERACTIONS. Rubbia, C. (CERN, Geneva). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 4.

The summary of weak interactions includes some basic properties of the $K^0-\bar{K}^0$ system, CP violation in neutral K decays, and neutral currents and other forbidden processes. (JFP)

27286 (CONF-720923-P4, pp 249-305) PERSPECTIVES ON THEORY OF WEAK INTERACTIONS. Lee, B. W. (State Univ. of New York, Stony Brook). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 4.

The review of weak interaction theory covers phenomenological implications, renormalizability, model building, physical constraints on models and higher order effects, and related phenomena. (JFP)

27287 (NP-20294-P2, pp vp Paper 4) WEAK INTERACTIONS: A REVIEW. Iliopoulos, J. (CERN, Geneva). 1973. (In French and English).

In summer school on particle physics, Gif-sur-Yvette, France, 24 September–6 October 1973. Volume II.

Known properties of weak interactions are reviewed. It is then shown that there exist several models which, without contradicting the present experimental data, combine the fundamental vector character of the interaction with renormalizability. (FR)

27288 (UCRL–51750) NEUTRAL CURRENTS AND PARITY BREAKDOWN IN ATOMIC TRANSITIONS: THREE PROPOSED EXPERIMENTS. Bloom, S. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Feb 1975. Contract W-7405-Eng-48. 31p. Dep. NTIS $4.00.

Three proposed experiments for observing the breakdown of parity in atomic transitions due to the exchange of neutral, parity-violating currents arising from some of the new gauge models (e.g., the Weinberg model) for the weak interaction. The experiments are based on exploiting a suggestion, by Bouchiat and Bouchiat, that modern laser technology be utilized to produce intense, monochromatic, and polarized photon beams with which to excite forbidden atomic transitions of the basic form $|ns1/2) \to |n's1/2)$. The asymmetries (of the order of 10^{-4}) in the de-excitation processes then signal the presence of the parity-violating components due to the neutral currents. In all three experiments suggested here, the use of multiple (uncollimated) atomic beams as targets forms a basic part, and their advantages over a temperature-equilibrium vapor are described. The first experiment uses $_{55}$Cs atomic beams as a target; the second uses $_{37}$Rb in conjunction with a superstrong magnetic field (~80 kG); the third uses $_{81}$Tl and requires frequency doubling of the exciting laser beam. All three experiments appear to be quite feasible, and, given the requisite equipment (much of which is or soon will be commercially available), they could yield definitive results in a period of a few months. (auth)

27289 SCALE DIMENSION OF CHIRAL SYMMETRY BREAKING AND RIGOROUS CONSTRAINTS ON K_{l3} DECAY. Baluni, V. (Stanford Linear Accelerator Center, Calif. (USA)); Broadhurst, D. J. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 84: No. 1, 178-200(6 Jan 1975).

Using new techniques for deriving bounds satisfying the requirements of unitarity and analyticity, optimal constraints on the scalar K_{l3} form factor are obtained, given the s-wave, $I = \frac{1}{2}$, $K\pi$ elastic phase shift. It is assumed that the propagators of current divergences satisfy unsubtracted dispersion relations, that axial divergences are dominated by pion and kaon poles and that the chiral symmetry breaking Hamiltonian transforms as $(3,\bar{3}) + (\bar{3},3)$. Recent SLAC-Santa Cruz data satisfy these constraints, as does the Callan-Treiman relation. The constraint on the slope of the form factor, given either the Callan-Treiman

relation or the data, is badly violated by the current algebra prediction of Dashen and Weinstein. This violation suggests the necessity for subtraction, corresponding to a chiral symmetry breaking Hamiltonian density with scale dimension greater than or equal to two. The results depend only weakly on the elastic phase shift. (auth)

27290 CONSTRAINTS ON THE REACTION $\nu_\mu(\overline{\nu}_\mu) + Z \rightarrow \nu_\mu(\overline{\nu}_\mu) + \mu^- + \mu^+ + Z$ IN THEORIES WITH NEUTRAL CURRENTS. Sehgal, L. M. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.). Nucl. Phys., B; 84: No. 1, 122-126 (6 Jan 1975).

In the presence of neutral lepton currents, the characteristics of the reaction $\nu_\mu(\overline{\nu}_\mu) + Z \rightarrow \nu_\mu(\overline{\nu}_\mu) + \mu^- + \mu^+ + Z$ are modified from those expected in the conventional V-A theory. It is shown that in a very general class of intermediate boson theories, the modification produced can be specified entirely in terms of the cross sections for $\nu_\mu(\overline{\nu}_\mu) + e^- \rightarrow \nu_\mu(\overline{\nu}_\mu) + e^-$. Such a constraint does not necessarily exist in models with four-fermion interaction. (auth)

27291 VIOLATION OF THE POMERANCHUK THEOREM IN PERTURBATION THEORY. Lukaszuk, L. (Institute of Nuclear Research, Warsaw (Poland)); Pham, X. Y. (Paris-11 Univ., 91 - Orsay (France). Div. de Physique Theorique). Phys. Lett., B; 53: No. 3, 287-289(9 Dec 1974).

It is shown that the renormalizable non-Abelian gauge theories naturally violate the Pomeranchuk theorem in 4th-order perturbation theory. The consequences are briefly discussed. (auth)

27292 ARE THE ELEMENTARY QUARK COUPLINGS OF THE NEUTRAL CURRENT EITHER PURE VECTOR OR PURE AXIAL VECTOR? Gronau, M. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). Phys. Lett., B; 53: No. 3, 260-262 (9 Dec 1974).

The quark parton model is used to study the neutral current fragmentation into hadrons in neutrino scattering on isoscalar nuclei. Equalities between $\pi^\pm$ multiplicities in ν and $\overline{\nu}$ scattering are suggested to test the spatial structure of the neutral current. (auth)

27293 HADRON DECAYS. Stech, B. (Univ., Heidelberg). J. Phys. (Paris), Colloq.; No. 1, 71-81(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Semi-leptonic decays of hyperons and mesons, nonleptonic decays, CP-violating decays, and the $K_L \rightarrow \mu^+\mu^-$ decay are reviewed. For each of these processes weak interaction models, symmetry breaking, selection rules, current coupling are discussed. (France)

27294 WEAK INTERACTIONS. Summary of the Parallel Sessions. Soergel, V. (Univ., Heidelberg). J. Phys. (Paris), Colloq.; No. 1, 83-90(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The results of papers presented at parallel sessions are given. They concern: Λ_0 lifetime, $\Delta S = 2$ transitions, the $K_L^0 \rightarrow \pi^+\pi^-\pi^0$ decay, the $\Sigma^- \rightarrow ne^-\nu$ decay, the $K^+ \rightarrow e^+\nu\gamma$ decay, K_{13} form factors, the $K_L^0 \rightarrow \mu^+\mu^-$ decay, and CP violation. (France)

27295 RECENT PROGRESS IN GAUGE THEORIES OF WEAK, ELECTROMAGNETIC, AND STRONG INTERACTIONS. Weinberg, S. (Harvard Univ., Boston). J. Phys. (Paris), Colloq.; No. 1, 45-67(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The following topics are reviewed: models and experiments; derivation of gauge invariance from high energy constraints; reggeization of gauge theories; dynamical breakdown of gauge symmetries; neutral currents and astrophysics; natural symmetries and symmetry breaking; strong interactions and hadronic symmetries; and asymptotic freedom. (France)

27296 ELECTROMAGNETIC INTERACTIONS OF HADRONS 1973. Gatto, R. (Univ., Rome). J. Phys. (Paris), Colloq.; No. 1, 3-19(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

A concise review of the recent developments concerning electromagnetic interactions of hadrons, and a general picture of the modern problematics in this field are presented. Particular emphasis is given to the present theoretical views on scaling and its possible realizations in physical models. The following subjects are treated: Possible new neutral exchanges in addition to photon; photoproduction; inclusive electroproduction; electron-positron annihilation; one-particle inclusive electroproduction; the renormalization group approach, asymptotic freedom. (France)

27297 NEUTRINO PRODUCTION OF M^+ AND E^+ HEAVY LEPTONS. II. Albright, C. H.; Jarlskog, C.; Wolfenstein, L. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 84: No. 2, 493-502(13 Jan 1975).

A theoretical analysis is made of possible experimental searches for the production of M^+ heavy leptons in inclusive neutrino reactions by detection of their decay into μ^+. Distributions of observable energy E_{obs} (sum of hadron and muon energies) and of the apparent y variable y_{obs} ($y_{obs} = E_{had}/E_{obs}$) are presented. These distributions are used to discuss the problem of distinguishing M^+ production from effects of antineutrino admixtures in a neutrino beam. (auth)

27298 EXPERIMENTAL STUDY OF STRUCTURE FUNCTIONS AND SUM RULES IN CHARGE-CHANGING INTERACTIONS OF NEUTRINOS AND ANTINEUTRINOS ON NUCLEONS. Deden, H.; Hasert, F. J.; Krenz, W.; von Krogh, J.; Lanske, D.; Morfin, J.; Schultze, K.; Weerts, H. (Technische Hockschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Bertrand-Coremans, G. H.; Sacton, J. Nucl. Phys., B; 85: No. 2, 269-288(27 Jan 1975).

The differential cross sections in freon (CF_3Br) of inclusive charge-changing neutrino and antineutrino interactions on nucleons, in the energy range E = 1 to 11 GeV, were determined with respect to the Bjorken scaling variables $\chi = q^2/2M\nu$ and $\gamma = \nu/E$. For $q^2 > 1$, $W^2 > 4$ GeV^2, the χ and γ distributions are consistent with scaling. In terms of the Bloom-Gilman variable $\chi' = q^2/(2M\nu + M^2)$, structure functions $\overline{F}_2^{\nu N}(\chi')$ and $F_2^{\nu N}(\chi')$ can be defined and are found to be, within the errors of 10 to 20%, independent of E, $\overline{F}_2^{\nu N}(\chi')$ agrees well with the scaling function $3.6\ F_2^{eN}(\chi')$ for deep inelastic electroproduction on a nucleon. Assuming $\overline{F}_2$ and $\overline{F}_3$ represent the high energy asymptotic region, for the quark charge, the Gross/Llewellyn-Smith and the Alder sum-rules are found: $\int \overline{F}_2^{\nu N}\, d\chi' / \int F_2^{eN}\, d\chi' = 3.6 \pm 0.3$, (quark model: 3.6), $\int \overline{F}_3^{\nu N}(\chi')\, d\chi = 3.2 \pm 0.6$ (quark model: 2.9), and $(d\sigma^{\nu N} - d\sigma^{\overline{\nu}N})/dq^2 < 0.3\ G^2/\pi$, for isoscalar target. The observed quark and antiquark momentum distributions are compatible with the predictions of quark-parton models fitted to electron scattering data. (auth)

27299 NEUTRINO PRODUCTION OF M^+ AND E^+ HEAVY LEPTONS. I. Albright, C. H.; Jarlskog, C. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 84: No. 2, 467-492(13 Jan 1975).

A theoretical study is made of M^+ and E^+ heavy lepton production in inclusive neutrino reactions. The production cross sections on protons are found to be enhanced over those for isoscalar targets and can in principle exceed the cross sections for the ordinary $\nu_\mu + p \rightarrow \mu^- + X$ process at high energies. New estimates are given for the decay branching ratios taking into account the SPEAR data on electron positron annihilation. Monte Carlo techniques are employed to calculate $q^2 - \nu$ spectra and y distributions for both the production process where $\nu_\mu \rightarrow M^+$ and the effective process where $\nu_\mu \rightarrow \mu^+$. The normalized results are rather insensitive to the set of structure functions used. (auth)

27300 PHENOMENOLOGY OF NEUTRAL CURRENTS. Wolfenstein, L. (Carnegie-Mellon Univ., Pittsburgh). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 84-113(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A general form of a neutral current-current weak interaction is discussed. Recent and prospective neutrino experiments and possible electron (or muon) experiments are analyzed as methods of determining unknown coupling constants in this general form. The evidence against strangeness-changing neutral currents is reviewed. The present limited data allows the simple Weinberg model but also allows completely different explanations. (auth)

27301 RADIATIVE CORRECTIONS TO WEAK INTERACTIONS. Sirlin, A. (New York Univ.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 114-126(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Some recent developments in the field of radiative corrections to weak interactions in the framework of gauge theories are discussed. The main emphasis is on the question of radiative corrections to superallowed Fermi transitions and the closely connected problem of Cabibbo universality, and some general properties of the radiative corrections to semileptonic $\Delta Q = 1$ processes. Recent estimates for the rare decay modes of K mesons are also briefly discussed. The analyses reported were carried out in the framework of simple hadronic extensions of the $SU(2)_L \times U(1)$ gauge model of Weinberg and Salam. (auth)

27302 COMPUTATIONAL ASPECTS OF QUANTUM ELECTRODYNAMICS: THE LEPTON G FACTORS. Roskies, R. Z. (Univ.

of Pittsburgh). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 376-394(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

The present and near-future situations concerning the lepton g factors are reviewed. Some aspects of the analytic and numerical techniques used to calculate these quantities are discussed. (auth)

27303 UNITY OF BARYONS AND LEPTONS. Pati, J. C. (Univ. of Maryland, College Park). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 604-622(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

The discussion of the unity of baryons and leptons includes the choice of the fundamental fermions: the basic model, electric charge, the basic gauge model, exotic interactions within the basic model, variants to the basic model, and quark and proton decays into leptons plus pions. (JFP)

27304 THEOREM ON THE SCALAR FORM FACTOR IN K_{β} DECAY. Auvil, P.R.; Pritchett, P.L. (Department of Physics, Northwestern University, Evanston, Illinois 60201). Phys. Rev. Lett. 34: No. 9, 555-557 (3 Mar 1975).

A current–algebra result is derived for the slope of the scalar form factor in K_{β} decay which is valid at all momentum transfers. This theorem is compared with the previous results of Dashen and Weinstein and Dashen, Li, Pagels, and Weinstein. Our analysis indicates that there are large corrections to these previous results at $t=m_{\kappa}^2+m_{\pi}^2$. (auth)

27305 TESTS OF NEUTRAL–CURRENT MODELS IN ELASTIC NEUTRINO SCATTERING. Sakurai, J.J.; Urrutia, L.F. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 11: No. 1, 159-163 (1 Jan 1975).

We discuss the elastic scattering of neutrinos (antineutrinos) on protons, nuclei, and electrons within the framework of some popular models of neutral currents. (auth)

27306 NONVANISHING NEUTRINO MASS AND THE PROCESS $\gamma\gamma \rightarrow \nu\bar{\nu}$. Halprin, A. (Physics Department, University of Delaware, Newark, Delaware 19711). Phys. Rev. D 11: No. 1, 147-149 (1 Jan 1975).

Within the framework of the local $V-A$ theory, I find that the experimental uncertainty in the μ–neutrino mass is not sufficiently great to allow the process $\gamma\gamma \rightarrow \nu\bar{\nu}$ to be an important neutrino energy–loss mechanism in stellar objects. (auth)

27307 SYMMETRY PROPERTIES OF WEAK NEUTRAL CURRENTS: An ANALYSIS OF CROSS–SECTION RATIOS IN NEUTRINO REACTIONS. Cordes, J.G.; Kiang, D.; Tsai, S.Y. (Department of Physics, Dalhousie University, Halifax, Nova Scotia, Canada). Phys. Rev. D 11: No. 1, 81-88 (1 Jan 1975).

Starting from a general neutral hadronic current in the quark model, we derive formulas which express various neutral–current versus charged–current cross–section ratios in terms of the parameters involved in that current. These formulas are useful in analyzing symmetry properties of the weak neutral currents. The processes investigated include the elastic neutrino–nucleon scattering, the neutrino–induced production of a single pion, and the inclusive neutrino reactions. An analysis of existing data indicates that some simple structures for this current are already excluded or are unfavorable, and that the success of the Weinberg model is indeed very impressive. The importance of isobar production data in such an analysis is clarified. (auth)

27308 CONSEQUENCES OF A SIMPLE PHENOMENOLOGICAL $V-A$ MODEL FOR NEUTRAL CURRENTS. Adler, S.L. (The Institute for Advanced Study, Princeton, New Jersey 08540); Tuan, S.F. Phys. Rev. D 11: No. 1, 129-132 (1 Jan 1975).

We examine the experimental implications of a simple phenomenological $V-A$ model of neutral currents, in which the neutral current belongs to the same generalized isospin triplet as the charged currents with zero Cabbibo angle, and in which the current–current effective Lagrangian describing neutral–current interactions has a different over–all strength from that describing charged–current couplings. (auth)

27309 STRONG W–BOSON PAIR MODEL AND THE J PARTICLES. Marshak, R.E.; Mohapatra, R.N. (The City College of the City University of New York, New York, New York 10031). Phys. Rev. Lett. 34: No. 7, 426-429 (17 Feb 1975).

We suggest that the two recently observed narrow resonances J (3108 MeV) and J (3695 MeV) be identified with the two neutral members of a U(3) triplet of W bosons mediating the weak interactions and enjoying a strong pairwise interaction with hadrons. This model was proposed by Okubo, Ryan, and Marshak in 1964 to explain the large mass of the W bosons and the $\Delta I=1/2$ selection rule in nonleptonic decays. (auth)

27310 CLASSICAL, COVARIANT FINITE-SIZE MODEL OF THE RADIATING ELECTRON. Sorg, M. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Theoretische und Angewandte Physik). Z. Naturforsch., a; 29: No. 11, 1671-1684(Nov 1974).

The finite extension of the classical electron is defined in a new, covariant manner. This new definition enables one to calculate exactly the bound and emitted four-momentum and to find an equation of motion different from the Lorentz–Dirac equation and from other equations proposed in the literature. Neither mass renormalization nor use of advanced quantities or asymptotic conditions are necessary. Runaway solutions and pre-acceleration do not occur in the framework of the model presented here. (auth)

27311 WEAK INTERACTIONS IN NUCLEI. Fiorini, E. (Univ., Milan). Riv. Nuovo Cim.; 4: No. 4, 401-444(1974).

The review covers the possible violation of G parity and the consequent existence of second-class currents, the reasonably well established parity violation in nuclei, and the as yet undiscovered violation of T invariance. The possible violation of the lepton conservation law in nuclei is also discussed. (JFP)

27312 NEUTRAL CURRENTS OF WEAK INTERACTIONS AND THE JOSEPHSON EFFECT. Vainshtein, A. I.; Khriplovich, I. B. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 68: No. 1, 3-7(Jan 1975). (In Russian).

It is possible to detect a parity nonconserving interaction between electrons and nucleons on basis of some effects in superconductors with polarized nuclei. In particular, the quantization condition for the magnetic flux and the magnitude of current flowing through a double Josephson junction are altered. Both effects depend on the relative orientation of the nuclear polarization and magnetic field enclosed by the contour. For heavy metals they may exceed 10^{-6} L, where L is the contour length in centimeters. (auth)

Strong (General)

Refer also to abstracts 27124, 27295, 27452, 27873, and 27879.

27313 (CONF-720923-P1, pp 182-186) QUARK MODEL AND RESONANCE COUPLINGS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The discussion of the quark model and resonance couplings includes $N^*N\gamma$ couplings and the quark model predictions, related symmetries and the quark model, and strange particle spectroscopy. (JFP)

27314 (CONF-720923-P1, pp 462-471) RECENT DEVELOPMENTS IN DUAL THEORY. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

Three developments which occurred during the past year in the formulation of a full-fledged theory of hadrons from understanding the structure of dual models and constructing new ones are reviewed. The topics covered are the construction of the spectrum generating algebra and the proof of the no-ghost theorem, developments in understanding the pomeron singularities which arise from nonplanar loop graphs, and the construction of new models using a dual-model analog to the spontaneous symmetry-breaking mechanism of field theory. (JFP)

27315 (CONF-720923-P1, pp 472-474) CLARIFICATION OF THE RUBBER STRING PICTURE. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The discussion of the rubber string pictures includes the dual model description of the hadron as an extended object, the Lagrangian density for the string system, the similarity between this theory and the usual quantum electrodynamics, and a comparison between the covariant quantization and the new transverse one. (JFP)

27316 (CONF-720923-P3) PROCEEDINGS OF THE XVI INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS, CHICAGO–BATAVIA, ILLINOIS, SEPTEMBER 6–13, 1972. Volume 3. Parallel Sessions: Strong Interactions. Jackson, J. D.; Roberts, A.; Donaldson, R. (eds.). (Chicago Univ., Ill.

(USA); National Accelerator Lab., Batavia, Ill. (USA)). 1972. 512p. Dep. NTIS $28.75.

Separate abstracts were prepared for the nine lectures presented. (JFP)

For abstracts of individual papers see: 27059, 27060, 27104, 27144–27146, 27317, 27391, and 27447.

27317 (CONF-720923-P3, pp 459-489) DYNAMICS OF STRONG INTERACTIONS. Low, F. E. (Massachusetts Inst. of Tech., Cambridge). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 3.

The discussion of the dynamics of strong interactions covers the present status of dual models, and multiperipheral models. (JFP)

27318 (NP-20294-P1) SUMMER SCHOOL ON PARTICLE PHYSICS, GIF-SUR-YVETTE, FRANCE, 24 SEPTEMBER–6 OCTOBER 1973. Volume I. Multiparticle Production. Berger, E.; Capella, A.; Krzywicki, A.; Le Bellac, M.; Petersson, B.; Salin, P. (Institut National de Physique Nucleaire et de Physique des Particules, 75–Paris (France)). 1973. 340p. (In French and English). Dep. NTIS (US Sales Only) $20.00.

Separate abstracts were prepared for the six lectures presented. (JFP)

For abstracts of individual lectures see: 27063, 27064, 27151, 27319, 27320, and 27412.

27319 (NP-20294-P1, pp vp Paper 4) MULTIPLICITY DISTRIBUTIONS. Le Bellac, M. (Univ., Nice). 1973. (In French).

In summer school on particle physics, Gif-sur-Yvette, France, 24 September–6 October 1973. Volume I.

The following properties of multiplicity distributions are examined: empirical laws on momenta and multiplicity distribution; two-component models; Koba-Nielsen-Olesen scale invariance; generator function and its applications: multiperipheral model, clustering...; correlations between neutral and charged particles. (FR)

27320 (NP-20294-P1, pp vp Paper 5) MUELLER–REGGE PHENOMENOLOGY. Salin, P. (CERN, Geneva). 1973. (In French).

In summer school on particle physics, Gif-sur-Yvette, France, 24 September–6 October 1973. Volume I.

The Mueller-Regge phenomenology is introduced, emphasis, being given to the following aspects: optical theorem; various Regge limits; energy dependence: comparison with experiments; analysis of a few inclusive distributions; triple Regge analysis; study of trajectories; constraints due to internal symmetries in a Mueller-Regge model; factorization and exchange degeneracy; semi-local duality; correlations; polarizations. (FR)

27321 (SLAC-179(Vol.1)) PROCEEDINGS OF SUMMER INSTITUTE ON PARTICLE PHYSICS, JULY 29–AUGUST 10, 1974. Volume I. The Strong Interactions. Zipf, M. C. (ed.). (Stanford Linear Accelerator Center, Calif. (USA)). Nov 1974. Contract AT(04-3)-515. 468p. (CONF-740739-P1). Dep. NTIS $10.60.

There were nine lectures. Separate abstracts were prepared for each lecture. (JFP)

For abstracts of individual papers see: 27065, 27154, 27322–27325, 27359, 27360, and 27460.

27322 (SLAC-179(Vol.1), pp 327-360) LECTURES ON INCLUSIVE HADRONIC PROCESSES. Sivers, D. (Stanford Linear Accelerator Center, CA). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume I.

These are "low profile" lectures intended to present some ideas on inclusive processes with a minimum of extraneous formalism. How many features of the data are empirically described by simple rules common to many models is discussed. Important questions in Mueller-Regge phenomenology are presented, and some aspects of cluster models are introduced. (auth)

27323 (SLAC-179(Vol.1), pp 361-397) LARGE MOMENTUM TRANSFER PROCESSES. Blankenbecler, R. (Stanford Linear Accelerator Center, CA). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume I.

Lectures are given presenting an overall and unified description of large momentum transfer processes and the way in which they join smoothly onto the familiar descriptions of the Regge and resonance regions at small momentum transfer. Physically motivated arguments are given rather than mathematical detail. The constituent interchange model is used. Strong interaction processes are discussed at two levels: the short range and the long range behavior of hadronic matter. (JFP)

27324 (SLAC-179(Vol.1), pp 399-444) HADRON DYNAMICS. Abarbanel, H. D. I. (National Accelerator Lab., Batavia, IL). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume I.

Developments in the dynamics of hadrons and their interactions are presented using the thread of the renormalization group to hold the fabric together. After an introduction to the ideas and equations of the renormalization group the solution to and usefulness of these equations are discussed. Armed with this tool one considers in some depth two seemingly disparate aspects of hadron physics: gauge theories of the strong interactions–in particular, ultraviolet freedom and deep inelastic scattering, models of hadron structure, the use and necessity of charm and color, and so on are discussed. Diffraction scattering and the Pomeranchuk singularity–in particular, the Reggeon calculus, branch points in the J-plane, decoupling theorems, t-channel discontinuity formula for Reggeons, and so on are addressed. Some comments are presented on the relation of these two important subjects. Throughout the lectures there is an emphasis on pedagogy rather than subtlety. Ideas and elementary examples are stressed and the results of detailed calculations, when presented, are lifted out of the references like magic. This course of lectures should serve as an introduction, then, both to the mainstream of present ideas about hadrons and to the more advanced lectures to be given in the Topical Conference to follow this school. (auth)

27325 (SLAC-179(Vol.1), pp 445-462) BEGINNER'S STRING. Willemsen, J. F. (Stanford Linear Accelerator Center, CA). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume I.

A survey is given of the string model in order to introduce the vocabulary and provide a source of references. A definition of the string model, how can a hadron look like a string, the possibility of partons with spin, the value of the string model, are strings alive and well, and the relation of string with other concepts is given. (JFP)

27326 (SLAC-179(Vol.2)) PROCEEDINGS OF SUMMER INSTITUTE ON PARTICLE PHYSICS, JULY 29–AUGUST 10, 1974. Volume II. The Strong Interactions. Zipf, M. C. (ed.). (Stanford Linear Accelerator Center, Calif. (USA)). Nov 1974. Contract AT(04-3)-515. 345p. (CONF-740739-P2). Dep. NTIS $10.60.

There were 17 lectures, three of which appeared previously in NSA as 31: 18210; 31: 18211; and 31: 18233. Separate abstracts were prepared for 14 lectures. (JFP)

For abstracts of individual lectures see: 26589, 27020, 27021, 27066–27069, 27108–27110, 27155, 27327, 27413, and 27852.

27327 (SLAC-179(Vol.2), pp 107-120) IMPORTANCE OF ABSORPTION IN UNDERSTANDING HADRON INTERACTIONS. Kane, G. L. (Univ. of Michigan, Ann Arbor). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

Several aspects of hadron physics are considered, and the current situation in learning to take account of absorption and its implications is explored. The resonance spectrum, the two-body reactions, duality, inelastic and elastic scattering, and low mass diffraction are covered. (JFP)

27328 ELECTROMAGNETIC SELF-ENERGY OF CONFINED MASSLESS QUARKS. Chodos, A.; Thorn, C. B. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Phys. Lett., B; 53: No. 4, 359-361(23 Dec 1974).

A natural mechanism is proposed which may lead to finite, calculable, electromagnetic mass differences in models which picture the hadron as massless quarks confined to a finite region of space. The physical idea behind the mechanism is very simple. It is well-known that the electromagnetic self-mass of an unconfined massless fermion is finite (in fact, zero). Since the source

of the usual divergent self-masses (e.g., for massive fermions) is essentially a short-distance singularity, it is a reasonable conjecture that the confinement of a massless fermion to a finite region of space (as long as the field remains massless) will not alter the finiteness of the self-mass. Moreover, the confinement supplies a distance scale ~1 fm, so the self-mass should be $\sim\alpha/$ 1 fm. (NL)

27329 THE ORIGIN OF CHIRAL REPRESENTATION MIXING. Carlitz, R.; Tung, W. K. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). Phys. Lett., B; 53: No. 4, 365-368(23 Dec 1974).

The relation between the quark model and PCAC is studied. The Melosh transformation is derived in theories where chiral symmetry is realized in the Nambu–Goldstone mode. (auth)

27330 SIMPLE TESTS OF QUARK–NUCLEON RECIPROCITY. Zarmi, Y. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Phys. Lett., B; 53: No. 4, 351-354(23 Dec 1974).

Simple tests of the quark–nucleon reciprocity relation are proposed. Wave function corrections for nuclear targets are not necessary. Neutrino reactions can test this relation for each type of quark individually. (auth)

27331 CLASSIFYING BARYONS. Faiman, D. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 167-170(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

It is shown that at the present stage of its development the Melosh transformation as applied to baryon spectroscopy goes a considerable way towards providing a theoretical foundation for some already successful quark model and symmetry ideas. (France)

27332 STRONG INTERACTION THEORY. Amati, D. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 129-140(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Several theoretical approaches to strong interactions are described: the Regge pole picture, the pomeron approach, gauge theories as candidates for unifying strong, electromagnetic and weak interactions, and dual theories. (France)

27333 CUTS IN THE COMPLEX ANGULAR MOMENTUM PLANE. Halliday, I. G. (Imperial Coll. of Science and Tech., London). J. Phys. (Paris), Colloq.; No. 1, 141-144(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The recent advances in the theory of cuts in the angular momentum plane are reviewed: hard cuts, the quasi-stable pomeron, cut sign controversy. (France)

27334 ITERATIVE APPROACH OF THE POMERON. De Tar, C. (Massachusetts Inst. of Tech., Cambridge). J. Phys. (Paris), Colloq.; No. 1, 145-148(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The problem of constructing a model for the pomeron that would satisfy both s-channel and t-channel unitarity is studied. (France)

27335 APPROACH TO MULTIPARTICLE PRODUCTION. Satz, H. (Univ., Bielefeld, Ger.). J. Phys. (Paris), Colloq.; No. 1, 149-152(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

In any statistical description of multihadron production, the probability of an inclusive final state is determined by the corresponding level density. The statistical bootstrap condition of Hagedorn is an approach to the density level calculation. The solution of the bootstrap equation and the question of the physical content of the bootstrap approach are investigated. (France)

27336 PARTONS IN STRONG INTERACTIONS. Horn, D. (Tel Aviv Univ., Israel). J. Phys. (Paris), Colloq.; No. 1, 153-159(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

It is shown that the great success of the parton model is in its application to the structure of hadrons. The hadrons spectrum of parton reactions and the description of hadron-hadron collisions are then studied. (France)

27337 EXCLUSIVE DIFFRACTIVE DISSOCIATION. Lubatti, H. J. (Univ. of Washington, Seattle). J. Phys. (Paris), Colloq.; No. 1, 277-283(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

New results on exclusive diffractive dissociation of hadrons are reviewed. They include: $\pi^-p \to \pi^-\pi^-\pi^+p$ and $p^+p \to Y^+p$ interactions at high energies, interactions with a nuclear target, coherent production on nuclei, the observation of cross over and isospin decomposition, double diffractive dissociation and diffractive dissociation of Σ^-. (France)

27338 PARTON MODELS OF LARGE TRANSVERSE MOMENTUM PROCESSES. Polkinghorne, J. C. J. Phys. (Paris), Colloq.; No. 1, 421-425(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Electroproduction and weak interactions in the deep inelastic region encourage the idea that hadrons are made of constituents, or partons. One might hope that these constituents would also manifest themselves in purely hadronic reactions. If so, the best hope is to look at large transverse momentum phenomena. Parton models are used to study such reactions. (France)

27339 MULTIPERIPHERALISM AND ELASTIC SCATTERING. Teper, M. (London Univ. (UK)). Nucl. Phys., B; 85: No. 1, 121-140(20 Jan 1975).

Elastic scattering is calculated via unitarity, using a variety of multiperipheral models. Although special attention is paid to the effect of spinning cluster production, interference terms and phases, the forward elastic slopes thus calculated are still not consistent with experiment. An alternative type of dynamics is suggested. (auth)

27340 CORRELATIONS BETWEEN CHARGED AND NEUTRAL PARTICLES IN A CLUSTER MODEL. Baier, R. (Bielefeld Univ. (F. R. Germany). Abt. Theoretische Physik); Bopp, F. W. (Department of Theoretical Physics, Gesamthochschule Siegen, F. R. Germany). Nucl. Phys., B; 85: No. 1, 264-268(20 Jan 1975).

Correlations between charged and neutral pions at high energies are investigated in the framework of a cluster model in which neutral clusters have a decay distribution determined by isospin conservation and statistical independence. For $\langle n_0\rangle_{n_-}$ an asymptotic expansion around the mean $\langle n_-\rangle$ leading asymptotically to a quadratic form in n_- is derived and compared with data. (auth)

27341 HIGH-ENERGY FIXED-ANGLE ELASTIC SCATTERING. Farrar, G. R.; Wu, C. C. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 85: No. 1, 50-60(20 Jan 1975).

The leading behavior of high-energy, fixed-angle, hadron–hadron scattering is obtained in a model in which on-mass-shell colored quarks exchange colored gluons. The resultant differential cross sections are compared with the data, indicating that such a mechanism does not dominate the physical scattering process. (auth)

27342 STRING MODEL WITH BARYONS: TOPOLOGY; CLASSICAL MOTION. Artru, X. (Paris-11 Univ., 91-Orsay (France). Lab. de Physique Theorique et Hautes Energies). Nucl. Phys., B; 85: No. 2, 442-460(27 Jan 1975).

The model in which a meson is an open string with a quark at one end and an anti-quark at the other end is considered; a baryon is made of three strings joining at a point, and carrying quarks at their free ends. The triality condition is ensured by orienting the strings according to simple rules. These rules suggest the existence of an underlying magnetic monopole theory. Independently of this "explanation", the topological properties of the model are investigated by looking at the duality diagrams: existence of exotic hadrons, of five basic interactions between strings. Some renormalization diagrams are assigned a negative power of the Veneziano coupling constant. Then, taking the same action (the world-sheet area) as in the conventional string model, the equations of motion of a junction are set down. It is argued that the slope of the leading baryonic Regge trajectory is the same as that for the mesons. As an example of an application, the "sticking together" of two colliding strings is studied; it is found that it is classically forbidden at relative velocities greater than $(\frac{6}{7})^{\frac{1}{2}}$. (auth)

27343 VOLUME ELEMENT FOR LOOP DIAGRAM IN THE STRING PICTURE OF DUAL MODELS. Arfaei, H. (California Univ., Berkeley (USA). Dept. of Physics). Nucl. Phys., B; 85: No. 2, 535-544(27 Jan 1975).

Using perturbation theory and the vertex function for the joining and separation of strings, the momentum-independent part of the orientable loop diagram is calculated in the string picture of the orbital dual model. The calculation is done for the case where space-time has the critical dimensionality. (auth)

27344 LEPTON PAIR PRODUCTION IN THE STATISTICAL QUARK MODEL OF PARTICLE CLUSTERS. Montvay, I. (Bielefeld Univ. (F. R. Germany). Abt. Theoretische Physik). Phys. Lett., B; 53: No. 4, 377-380(23 Dec 1974).

The distribution of directly produced lepton pairs is calculated

in the statistical quark model of particle clusters. The shape of the single lepton distribution is hardon-like. The mass distribution of the lepton pairs is cut off exponentially at large masses. (auth)

27345 OF STRINGS, SHELLS, AND BAGS. Ramond, P. (Yale Univ., New Haven). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 437-455(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Several approaches to explain the extended structure of hadrons and their charge content in a relativistic way are reviewed. The first model is purely geometric and proposes to describe the hadron as a string moving in space-time. Unfortunately, the introduction of a geometry gives rise to quantum fluctuations which spoil the relativistic invariance of the theory (except in an unphysical number of dimensions). Yet it gives rise to a very nice picture of strong interactions in terms of the splitting of strings. Further, this model can only accommodate Abelian charges. The second approach is a hybrid one which associates local fields with the quark quantum numbers, but traps them relativistically in a region of space, called the bag. This bag model has very nice static solutions which roughly give the experimentally observed values for the static parameters of the hadrons. It remains to be seen if the model can accommodate its quantum fluctuations. Finally, the last approach is purely field theoretical and relies on the peculiarities of the quark binding potential. There the quarks end up on a shell. (auth)

27346 PROBLEMS AND PROGRESS IN CONSTITUENT THEORIES OF HADRONS. Kogut, J. (Cornell Univ., Ithaca, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 456-480 (1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Quark confinement, asymptotic freedom and e^+e^- annihilation are discussed within the context of the SU(3)′ nonabelian gauge theory of three quartets of quarks. (auth)

27347 ASYMPTOTIC FREEDOM AND BJORKEN SCALING. Gross, D. J. (Princeton, Univ., NJ). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 583-595(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

The discussion of asymptotic freedom and Bjorken scaling also covers the structure of asymptotically free gauge theories of the strong interactions, and various applications. (JFP)

27348 SPONTANEOUS VACUUM TRANSITIONS IN DUAL MODELS. Volkov, D.V.; Zheltukhin, A.A.; Pashnev, A.I. (Physico-technical Institute, Ukrainian Academy of Sciences). JETP Lett. 20: No. 7, 222-223 (5 Oct 1974).

It is shown that spontaneous vacuum transitions exist in a dual model with trajectory intercept $\alpha_0 = -1$. (auth)

27349 MULTIPERIPHERAL DESCRIPTION OF CLUSTERING IN CHARGED-PARTICLE PRODUCTION IN THE CENTRAL PLATEAU. Snider, D.R. (Department of Physics, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201). Phys. Rev. D 11: No. 1, 140-146 (1 Jan 1975).

A two-channel Chew-Pignotti-type model is constructed which describes the two-charged-particle correlations and the rapidity-gap distribution for the nondiffractive component of the hadronic cross section at high energies. (auth)

27350 PRINCIPAL TENDENCIES IN THE DEVELOPMENT OF THE THEORY OF STRONG INTERACTIONS. Logunov, A.A.; Hieu, N.V. (Institute of High-Energy Physics, Serpukhov, USSR). Sov. J. Part. Nucl. 5: No. 3, 213-241 (Jan 1975).

The review summarizes the results of research on strong-interaction theory. It consists of three parts: symmetry theory, analytic approach, and current algebra. (auth)

27351 SIMPLE PROBABILISTIC MODEL FOR MULTIPARTICLE PRODUCTION. Majernik, V. (Inst. of Physics, Bratislava). Acta Phys. Austr.; 38: No. 4, 349-353(1973).

In a relatively simple Markovian model of the multiparticle production, one obtains a probability distribution of secondaries which, under plausible physical conditions of transfer probabilities, turns out to be the well known Poisson one. Some general features of the internal dynamics of the multiparticle production in this Markovian model are also discussed. (auth)

27352 GROUP EMBEDDING AND A MODEL OF HADRONS. Kostyrko, I. I. (Inst. of Mathematics, Kiev). Yadern. Fiz.; 20: No. 6, 1262-1266(Dec 1964). (In Russian).

The group embedding scheme, used earlier for the hydrogen atom model, is applied to the strongly interacting particles. An empirical expression for the mass spectra is obtained which determines the choice of the Hamiltonian. It is shown that the symmetry group for the present model of the hadrons is SU(3) ⊗ SU(3) and the dynamical symmetry is $\overline{SU}(7)$. (1 table) (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 27078 and 27365.

27353 (CONF-720923-P1, pp 1-2) Kπ PHASE SHIFTS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The Kπ elastic scattering was analyzed using an energy-independent phase-shift analysis for the reaction $K^+ p \to K^+\pi^-\Delta^{++}$ at 12 GeV/c for Kπ masses between 800 and 1000 MeV. The mass and width of the K(890) are found to be 896 ± 1.5 and 47 ± 2.8 MeV respectively. It is concluded that there is no resonance up solution if one believes in the extrapolation of Y_1^0, Y_2^0 and the total cross section. (JFP)

27354 (CONF-720923-P1, pp 9-14) I = 2 S- AND D-WAVE ππ PHASE SHIFTS IN THE LOW ENERGY REGION. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The brief review of the I = 2 S- and D-wave phase shifts in the low energy region shows that fair agreement was achieved in these phase shifts. (JFP)

27355 (CONF-720923-P1, pp 15-16) EXPERIMENTAL RESULTS ON ππ SCATTERING. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

Recent high statistics experiments on $\pi^- + p \to \pi^+\pi^-n$ and $\pi^+ + p \to \pi^-\pi^+0^{++}$ were analyzed to extract new information on ππ scattering. The I = 0 s-wave ππ scattering for ππ masses between 500 and 1100 MeV was determined. The phase shift is described. (JFP)

27356 (CONF-720923-P1, pp 96-103) REVIEW OF SPIN-PARITY ANALYSIS OF THE B MESON. Chung, S. U. (Brookhaven National Lab., Upton, NY). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The review of the spin-parity analysis of the B meson covers the particle properties, decay mode, and the formulas for the spin-parity analysis. It is concluded that the B is a healthy resonant state with the quantum numbers $I^G = 1^+$ and πω as the only certified decay mode. (JFP)

27357 (CONF-720923-P1, pp 286-315) π PRODUCTION IN INCLUSIVE REACTIONS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

A review is given of the inclusive reaction $a + b \to \pi^\pm$ + anything. Some of the interesting but discrete points made in previous work dealing with pion production at accelerator energies below 30 GeV and the approach to a limiting fragmentation behavior in the target region and to scaling in the central region are considered. (JFP)

27358 (DESY-75/02) COLOR VERSUS CHARM. Kitakado, S.; Walsh, T. F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jan 1975. 11p. Dep. NTIS (US Sales Only) $4.00.

The decay systematics (including inclusive decays) of the new mesons seen in e^+e^- collisions is discussed. The aim is to show how one can substantiate or demolish the color scheme, which is contrasted to the charm model. (auth)

27359 (SLAC-179(Vol.1), pp 179-185) PHENOMENOLOGY OF DIFFRACTIVE PRODUCTION OF THREE-PION SYSTEMS. Jones, L. (Univ. of Illinois, Urbana). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume I.

A lecture is given on various important nonresonant waves in the three-pion system. It is shown that a Reggeized Deck model of relatively naive form works well for these nonresonant waves and helps one to understand both their magnitude and their phases. The model is outlined, and certain features are pointed out which bear directly on the partial waves obtained from it. (JFP)

27360 (SLAC-179(Vol.1), pp 307-326) RESONANCES: A QUARK VIEW OF HADRON SPECTROSCOPY AND TRANSITIONS. Gilman, F. J. (Stanford Linear Accelerator Center, CA). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume I.

A discussion of a quark view of hadron spectroscopy and transitions covers symmetries and nonsymmetries, meson states, baryon states, transitions among hadrons, currents and quarks, and consequences for transition amplitudes. (JFP)

27361 HOW LARGE IS PION CHARGE RADIUS FROM DUBNA–UCLA FORM FACTOR MEASUREMENTS? Dubnicka, S.; Dumbrajs, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 53: No. 3, 285-286(9 Dec 1974).

Recent experimental values of the pion form factor in the space-like region have been reanalyzed in a model-independent way by using analyticity arguments. The most unbiased value of the pion charge radius has been found to be $\langle r^2 \rangle^{\frac{1}{2}} = 0.71 \pm 0.05$ fm. (auth)

27362 $\pi\pi$ PHASE SHIFT ANALYSIS IN THE f AND g RESONANCE REGION. Estabrooks, P.; Martin, A. D. (Durham Univ. (UK)). Phys. Lett., B; 53: No. 3, 253-259(9 Dec 1974).

An energy-independent $\pi\pi$ partial-wave analysis is performed in the energy range $1.0 < M_{\pi\pi} < 1.8$ GeV using high statistics $\pi^- p \to \pi^-\pi^+ n$ data at 17.2 GeV/c. The zeros of the $\pi\pi$ scattering amplitude are used to examine in detail the possible ambiguities and study the resulting $\pi^-\pi^+$ resonance spectrum. (auth)

27363 ON THE CALCULATION OF SCALAR MESONS IN FUNCTIONAL NONLINEAR SPINOR THEORY. Bauhoff, W. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Naturforsch., a; 29: No. 10, 1394-1406(Oct 1974).

22 refs.

The formulation of nonlinear spinor theory in functional space is used for the calculation of scalar meson masses. The second-order equation used requires an explicit angular momentum reduction. For illustration, this method is also applied to the first-order equation. In second order, we get an integral equation of the Bethe–Salpeter type which is solved in Fredholm approximation. (auth)

27364 COHERENT PRODUCTION OF CHARGED PIONS. Bilic, N.; Martinis, M. (Ruder Boskovic Inst., Zagreb). Fizika (Zagreb); 6: No. 3, 145-154(Oct 1974).

A particular model of coherent production of charged pions is suggested and restrictions due to momentum conservation, charge conservation and isospin conservation are dealt with in detail. Multiplicities $\langle n_0 \rangle$, $\langle n_+ \rangle$, and $\langle n_{ch} \rangle$ in $\pi^+ p$ scattering as well as the total cross sections $\sigma_{\pi^+ p}(n_0 n_+ n_-)$, $\sigma(\pi^+ p)$, dispersion D_{ch} and the correlation functions f^{2-}, f_3^{2-} and f_3^{2h} were calculated. The theoretical curves D_{ch} and f_3^{2-} as function of $\langle n_- \rangle$ are compared with existing experimental data. The results are consistent with presently available data, although further refinements of the model are necessary. (auth)

27365 RESULTS OF THE 3-MESON SYSTEM PARTIAL WAVE ANALYSIS. Otter, G. (Technisch Hochschule, Aachen). J. Phys. (Paris), Colloq.; No. 1, 233-234(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

New experimental and theoretical (partial wave analysis) results on the 3-meson system are reviewed. (France)

27366 MESON RESONANCES. Chaloupka, V. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 213-216(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The nonobservation of narrow peaks around 1 GeV and the two mass-independent analyses of the $\omega\pi$ system are discussed. (France)

27367 MESON–MESON THEORY. Basdevant, J. L. (Univ., Paris). J. Phys. (Paris), Colloq.; No. 1, 220-222(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

It is shown that considerable progress has been made in both experimental and theoretical studies of $\pi\pi$ scattering. It is now possible to exploit practically the fact that $\pi\pi \to \pi\pi$ is highly constrained by crossing and analyticity. (France)

27368 ANTIPROTON–PROTON INTERACTIONS. Muirhead, H. (Univ. of Liverpool). J. Phys. (Paris), Colloq.; No. 1, 365-368(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The antiproton-proton interaction is of considerable interest in the physics of high multiplicity processes, since the annihilation component allows one to study particle production processes in the absence of diffractive effects, and baryon exchange. (France)

27369 MULTIHADRON PRODUCTION IN NUCLEON–ANTINUCLEON ANNIHILATION AT REST IN THE STATISTICAL BOOTSTRAP MODEL. I. Multiplicity Distributions According to Different Bootstrap Versions. Moehring, H. J.; Kripfganz, J.; Ilgenfritz, E. M.; Ranft, J. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). Nucl. Phys., B; 85: No. 1, 221-238(20 Jan 1975).

Multihadron production in nucleon–antinucleon annihilation at rest is studied using the statistical bootstrap model. Different versions of the statistical bootstrap model are compared at nonasymptotic and asymptotic energies. The parameter of the model is determined from nucleon–antinucleon annihilation at rest. Data for $\bar{p}p$ and $\bar{p}n$ annihilation agree rather well with the model except for certain difficulties with neutral pions. Furthermore the fireball mass dependence of the bootstrap prediction is discussed and in this context the application of the statistical bootstrap model to $e^-e^+ \to$ hadrons. (auth)

27370 S-WAVE $\pi\pi$ SCATTERING AND THE S* POLES. Fujii, Y.; Fukugita, M. (Tokyo Univ. (Japan)). Nucl. Phys., B; 85: No. 1, 179-188(20 Jan 1975).

The I = 0 S-wave $\pi\pi$ scattering amplitude is analysed with a primary interest in the S*. The amplitude corresponding to the S* is parametrized in terms of pole positions. The recent CERN-Munich energy-independent partial-wave solution is reproduced better by an amplitude with two poles (on sheet II and sheet III) than by that with only one pole (on sheet II). The background phase is also analysed in detail and the long conjectured existence of the $\epsilon(700)$ is almost excluded. (auth)

27371 QUANTUM ELECTRODYNAMICS OF SPIN ONE-HALF AND SPIN ZERO PARTICLES IN EXTERNAL ELECTROSTATIC FIELDS OF ARBITRARY STRENGTH. Klein, A.; Rafelski, J. (Univ. of Pennsylvania, Philadelphia). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 356-375(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

The quantum theories of an otherwise free electron-positron field and of a charged pion field in the presence of the electrostatic field of an extended charge distribution of arbitrary strength are considered. In both instances, the standard quantization fails because of an instability of the vacuum as it is usually defined. The character of the instability, different in each case, is analyzed, and it is shown how a consistent quantization can be carried out. The possible observation of the instabilities, which appears feasible for the electron-positron field, is discussed. (auth)

27372 CONVENTIONAL HADRONIC MODEL OF THE NEW PARTICLES AT 3.1 AND 3.7 GeV. Tow, D.M.; Tan, C.; Kang, K.; Fried, H.M. (Department of Physics, Brown University, Providence, Rhode Island 02912). Phys. Rev. Lett. 34: No. 8, 499-501 (24 Feb 1975).

We suggest that ψ (3.1) and ψ (3.7) are a bound state and resonance, respectively, of the $\Omega^-\bar{\Omega}^+$ system, with decay of ψ (3.1) predominantly into three $\lambda\bar{\lambda}$ mesons. Conventional hadronic couplings may then be adopted, with the small ψ (3.1) width an automatic consequence of the bound–state nature and the small Q values of these decays. Branching ratios of ψ (3.1) and ψ (3.7) are calculated and crucial tests of the model pointed out. (auth)

27373 IS THE ψ (3100) A $\Omega\bar{\Omega}$ COMPOUND? Dürr, H.P. (Max–Planck–Institut für Physik and Astrophysik, Munich, Germany). Phys. Rev. Lett. 34: No. 7, 422-426 (17 Feb 1975).

It is proposed to connect the new narrow resonance with a d–wave bound state of the $\Omega\bar{\Omega}$ system where annihilation may be sufficiently suppressed by the centrifugal barrier. The width is estimated on the basis of the similar estimate for the ϕ and ρ. As an alternative, the possibility of relating the ψ and ψ' to a two–nucleon, two–antinucleon system is discussed. (auth)

27374 QUARK–MODEL COMPARISON ON THE NARROW e^+e^- RESONANCES. Kenny, B.G. (School of Physics, University of

Sydney, Sydney, New South Wales 2006, Australia); Peaslee, D.C.; Tassie, L.J. Phys. Rev. Lett. 34: No. 7, 429-432 (17 Feb 1975).

The narrow e^+e^- resonances ψ (3.1 GeV/c^2) and ψ (3.7 GeV/c^2) are used to test quark models: SU(3) ⊗SU(3)′encompasses them readily but also predicts four more such states: SU(4) includes more than one state only by extension to $(q\bar{q}\ q\bar{q})$ representations; the two-triplet model encounters severe difficulties: and scalar colored quarks seem practically excluded. The importance of photoproduction, especially of charged counterparts, is emphasized. (auth)

27375 FINITE-WIDTH EFFECTS AND SUBTRACTION CORRECTIONS FOR THE $A_2 \to 3\pi$ DECAY. Matsumoto, Y.; Cordes, J.G. (Department of Physics, Dalhousie University, Halifax, Nova Scotia, Canada). Phys. Rev. D 11: No. 1, 106-109 (1 Jan 1975).

Effects of interference between ρ-meson poles in the different channels and of substraction terms for the $A_2 \to 3\pi$ decay are estimated. Goldberg's formula for the interference correction is discussed and tested by numerical calculations. The FDR-FESR (finite dispersion relation-finite-energy sum rule) technique is used to estimate the correction due to the subtraction. It is found that the effect of a finite ρ width and also the subtraction effect lead to small corrections to the decay width. (auth)

27376 RESONANCE DECAYS USING SYMMETRIC VERTEX COUPLINGS. Morrow, R.A. (Bennett Hall, University of Maine, Orono, Maine 04473). Phys. Rev. D 11: No. 1, 133-135 (1 Jan 1975).

A previously formulated model of vertex functions based on (cyclic) permutation-symmetric field couplings (intimately related to dual amplitudes) is applied to various hadronic two-body decays to predict the relative mixture of partial waves involved. Included in the study are the B meson and several of the baryon resonances found in inelastic πp scattering from 1500 to 2000 MeV c.m. energy. In every case dominance of the lowest L but not necessarily the lowest S (in ρN decays) is predicted. This is in agreement with the data except in three cases. (auth)

27377 FIXED ANGLE METHOD FOR CROSSING SYMMETRIC UNITARIZATION OF REAL AMPLITUDES IN ππ SCATTERING. Lang, C. B. (Univ., Graz). Acta Phys. Austr.; 38: No. 4, 367-377(1973).

Partial wave amplitudes can be approximated by finite linear combinations of the amplitude at fixed angles; thus a partial wave integration can be avoided. The well known analytic structure of the partial waves allows for an unitary representation of the inverse amplitudes. Real amplitudes can be interpreted as CDD-contributions within this unitary representation. An iterative algorithm is proposed which unitarizes some given real amplitude; if the iteration converges the resulting amplitude is also crossing symmetric. (auth)

27378 NONLINEAR QUARK THEORY OF SPIN 2 (GRAVIMESONS). III. Funke, Kh. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 44-46(1974). (In Russian).

The nonlinear field equation of spin s = 2 was derived on the basis of the nonlinear quark theory by the confluence method. The octet of gravimesons were examined. A nonlinear equation was derived for neutral gravimesons (strong gravitation). (tr-auth)

27379 SPIN DETERMINATION OF QUASINUCLEAR MESON AND BARYON RESONANCES. Ots, I. (Inst. of Physics, Tartu). Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 23: No. 4, 418-420(1974). (In Russian).

Under the assumption that the basic contribution to the amplitude of the formation of quasinuclear resonances is given by the polar diagram, polarization effects in the formation of meson and baryon resonances were examined. This makes it possible in principle to determine the spin of the resonances. (tr-auth)

27380 FORMATION OF PSEUDOSCALAR MESONS DURING NEUTRINO-LEPTON INTERACTION. Abdullaev, S. K.; Sadykhov, F. S.; Radzhabov, P. (Azerbaidzhan State Univ., Baku). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 139-143(1974). (In Russian).

Processes for the formation of pseudoscalar mesons during interaction of antineutrinos with leptons $\nu_l l \to K\pi$, KK, ππ, and Kππ were examined. (tr-auth)

27381 PLANE WAVE SOLUTION OF THE VECTORIAL (PROCA) MESON. Boskovitz, I. Stud. Univ. Babes-Bolyai, Ser. Phys.; 19: No. 2, 17-22(1974).

The plane wave solutions of Proca's meson are found, and they are put in accordance with the plane wave solutions of other particles already known. (JFP)

27382 RECHARGE THEORY OF VECTOR BOSONS. Kostarev, A. I.; Ferents, P. R. (Odessa Technological Inst. of the Refrigeration Industry). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 84-87 (1974). (In Russian).

The well known Klein paradox, formulated in the Sakata-Taketani representation, was studied. It was shown that during passage of the vecton from the region with V(x) = 0 to the region with V(x) ≫ 2 mc^2 its transition into the antiparticle state is possible. It was concluded that in the problem considered spin does not affect the results of the process. (tr-auth)

Strong (Baryon No. = 1)

27383 (CONF-720923-P1, pp 22-30) PARTIAL WAVE ANALYSIS IN πN AND RELATED TOPICS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The discussion of partial wave analysis in πN scattering covers new πN phase shift analyses, new measurements, and parametrization of resonances. (JFP)

27384 (CONF-720923-P1, pp 31-39) INELASTIC REACTION $\pi N \to \pi\pi N$ IN THE RESONANCE REGION. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The discussion of the inelastic reaction $\pi N \to \pi\pi N$ in the resonance region covers the isobar model and assumptions, the fitting method using partial waves, and the goodness of the fits including histograms of masses and angles, ω and cross sections, and comparison with elastic phase-shift analyses. (JFP)

27385 (CONF-720923-P1, pp 40-55) SEARCH FOR Z*S. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

A summary is given of KN scattering and partial-wave analysis, and an attempt is made to indicate where further work would be desirable. Included are K^+p elastic scattering, K^+p and K^+d total cross sections, K^+p partial-wave analysis, conclusions on the I = 1 system, the previous status of the I = 0 system, K^+n elastic scattering, I = 0 phase-shift analyses, $K^0_L\ p \to K^+n$ results, differential and total cross sections and conclusions on the I = 0 system. (JFP)

27386 (CONF-720923-P1, pp 56-77) Y* SEARCH. Lasinski, T. A. (Univ. of California, Berkeley). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

An attempt is made to summarize the Y* situation in the 1600 to 1900 MeV mass region particularly the lower partial waves (S, P_1, P_3, and D_3). Included are old and new data, method of partial-wave analysis, comparisons of the solutions, and the Y(1405). (JFP)

27387 (CONF-720923-P1, pp 159-181) SU(3) CLASSIFICATION OF BARYON RESONANCES. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The review of SU(3) classification of baryon resonances covers the new data, individual multiplets for which the amount of data available is sufficient to perform constrained fits, and other possible multiplets. Large discrepancies for unbroken SU(3) fits to the couplings seem to persist in the $\frac{3}{2}^+$ decuplet and the $\frac{1}{2}^-$ octet and singlet states. (JFP)

27388 (CONF-720923-P1, pp 190-192) DUALITY FOR BARYONS: QUARK MODEL RESULTS WITHOUT QUARKS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

For baryons there are well-known difficulties in constructing simple and predictive dual models. Therefore one uses a general duality tool, abstracted from the simple B_4 model for mesons. This new tool is called local superconvergence relations. This

tool is applied to $0^- \frac{1}{2}^+ \rightarrow 0^- \frac{1}{2}^+$. As output all coupling ratios which occur for the $\frac{1}{2}^+$, $\frac{3}{2}^+$, and 1^- resonances are determined. The predictions are identical to those of the quark model. (JFP)

27389 (CONF-720923-P1, pp 262-276) MULTIPARTICLE PRODUCTION IN πN COLLISIONS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

Multiple production in πN interactions is reviewed, and a very simple empirical rule by Wroblewski explaining this production is discussed. (JFP)

27390 (CONF-720923-P1, pp 316-329) STRANGE PARTICLE INCLUSIVE REACTIONS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

A review is given of hyperon and neutral kaon production in inclusive interactions. Hyperon and kaon production does not appear to scale at accelerator energies. However, particle production attributable to diffractive processes has slower energy dependence than particle production which is not mainly of a diffractive nature, which may be independent of the degree of exoticity of the reaction. (JFP)

27391 (CONF-720923-P3, pp 73-148) BARYON RESONANCES AND RELATED PHENOMENOLOGY. Lovelace, C. (Rutgers–The State Univ., New Brunswick, NJ). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 3.

The treatment of baryon resonances and related phenomenology covers stability against high waves, optimal tautologies for pedestrians, end of the σ term, the Z question, elastic πN settles down, isobar model expanding, Y* daughters exposed, how to cook a quark, and doublets not in fashion. (JFP)

27392 THE ISOSPIN BOUNDS AND PHASE-CONTOURS IN PION–NUCLEON SCATTERING. Ion, D. B. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Phys., B; 84: No. 1, 55-69(6 Jan 1975).

The isospin constraints on differential and integrated (unpolarized and polarized) cross sections are investigated in pion-nucleon scattering. Defining $\Sigma^{(n)}$-integrated cross sections and using the classical Minkowski and Holder inequalities a large class of isospin bounds is obtained. The saturation of the isospin bounds is investigated using dispersion relation predictions and a CERN theoretical solution for the phase shifts. (auth)

27393 EXOTIC EXCHANGE. Akerlof, C. W. (Univ. of Michigan, Ann Arbor). J. Phys. (Paris), Colloq.; No. 1, 303-304(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Examples of reactions that seem to be dominated by exchange forces are presented. (France)

27394 RAPIDITY DISPERSION ANALYSIS OF INDIVIDUAL EVENTS IN π^+p INTERACTIONS AT 8 TO 23 GeV/c. Graessler, H.; Kirk, H.; Rumpf, K. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Klein, M.; Nahnhauer, R. (Akademie der Wissenschaften der DDR, Berlin); Boeckmann, K.; Hartmann, R.; Idschok, U. (Bonn Univ. (F. R. Germany). Physikalisches Inst.); Berger, E. L.; Coghen, T. Nucl. Phys., B; 85: No. 1, 1-13(20 Jan 1975).

An analysis has been performed of the dispersion of the rapidity spectrum of particles in individual events from well-identified exclusive channels of π^+p interactions at 8,16 and 23 GeV/c. Emphasis is placed on testing the effectiveness of the method for separating different reaction mechanisms as a function of energy and multiplicity. By comparing data with simulated events generated according to transverse momentum limited phase space, an attempt is made to distinguish kinematical from dynamical features of the dispersion plots. The dispersion method isolates pion and baryon dissociation events fairly clearly for sufficiently small masses of the excited systems. (auth)

27395 PION–NUCLEON BACKWARD SCATTERING: THE LOCATION OF THE AMPLITUDE ZEROS. Buttimore, N. H.; Spearman, T. D. (Trinity Coll., Dublin (Ireland)). Nucl. Phys., B; 84: No. 2, 531-547(13 Jan 1975).

The complex zero trajectories for the πN helicity amplitudes with definite u-channel isospin are determined from phase shifts. Some of these trajectories display systematic behaviour, having fixed values of $(u-u^0)$, where u^0 corresponds to the backward direction, and small values of Im u. On the assumption that this systematic behaviour will persist to higher energies one can make predictions about the locations of zeros in these helicity amplitudes at high energies. These zero locations are very relevant to an understanding of the mechanisms involved in πN backward scattering. The results, which show quite a striking pattern for the zero positions in the various amplitudes, are discussed from the point of view of the experimental data for πN backward scattering and of a theoretical interpretation of the interaction mechanism. (auth)

27396 ON RESONANT $\pi^+p \rightarrow \pi^+p\gamma$ CALCULATIONS. Beder, D. S. (British Columbia Univ., Vancouver (Canada). Dept. of Physics). Nucl. Phys., B; 84: No. 2, 362-374(13 Jan 1975).

A current-conserving calculation of $\pi^+p \rightarrow \pi^+p\gamma$ using a Lagrangian (isobar) description of $\pi p \rightarrow \pi p$ was carried out for resonant πp kinematics. After examination of a large range of modifications of the basic description, there remains a dramatic discrepancy between theory and experiment. A recipe is given, unjustified but motivated, which gives good agreement with present data. (auth)

27397 EVIDENCE FOR UNNATURAL SPIN-PARITY STATES OF $(K\pi\pi)^0$ IN THE CHARGE-EXCHANGE REACTION $K^-p \rightarrow (\bar{K}^0\pi^+\pi^-)n$. Otter, G.; Radolph, G.; Schmitz, P.; Wieczorek, H. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Lohmann, W.; Vogt, H. (Akademie der Wissenschaften der DDR, Berlin); Berger, E. L.; Cocconi, V. T.; Hansen, J. D.; Kotanski, A. Nucl. Phys., B; 84: No. 2, 333-341(13 Jan 1975).

A partial-wave analysis of the $(K\pi\pi)^0$ system produced in the charge exchange reaction $K^-p \rightarrow (\bar{K}^0\pi^+\pi^-)n$ was made in the mass range $1.04 \leq M\ (K\pi\pi) < 1.56$ GeV combining data at 8, 10, and 16 GeV/c. It was found that in about ⅔ of the cases, the $(K\pi\pi)^0$ system is produced in states of unnatural spin-parity, namely $J^P = 0^-$ and 1^+; the rest is in the natural spin-parity state $J^P = 2^+$. The 2^+ state is consistent with being all K*(1420). The unnatural spin-parity states are produced mostly (~80% of the events) by natural parity exchange. The facts that unnatural spin-parity states are produced in this nondiffractive channel, with $J^P = 1^+$ dominant, and that the exchange responsible for their production is mostly of natural parity, are similar to what was found for the charged $(K\pi\pi)^-$ system in the diffractive reaction $K^-p \rightarrow (K\pi\pi)^-p$. However, the absolute value and the energy dependence of the cross sections are very different in the two cases. (auth)

27398 SCALING BEHAVIOUR OF CHARGED SPIN-ONE PARTONS IN A GAUGE MODEL. Furman, M. A. (California Univ., Santa Cruz (USA)); Komen, G. J. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 84: No. 2, 323-332(13 Jan 1975).

In a hadron model in which the fermion constituents are bound by vector-isovector gauge fields, electromagnetism is introduced; by spontaneously breaking the strong (SU(2)), gauge symmetry, the gauge fields become massive. The spinors and vectors are identified with partons, and, assuming the naive parton model hypothesis, the cross section $e^+e^- \rightarrow$ hadrons and the structure functions of the nucleon are calculated; scaling is obtained despite the presence of an anomalous magnetic moment term in the coupling of the photon with the charged vector fields; the reason is that the spontaneous breaking of the symmetry induces a vector-meson dominance type of coupling between the photon and the neutral vector, which is just what is necessary to restore scaling. (auth)

27399 ROLE OF COMPLEX POLES IN A FIELD–THEORETICAL MODEL FOR πN SCATTERING. Nutt, W.T.; Wilets, L. (Physics Department, University of Washington, Seattle, Washington 98195). Phys. Rev. D 11: No. 1, 110-118 (1 Jan 1975).

The "uncrossed meson line" approximation for the nucleon propagator is appled to the pion–nucleon S matrix. The resulting simplification resembles the Born approximation, but with the dressed nucleon propagator of Brown, Puff, and Wilets (BPW), which contains a pair of conjugate complex poles. The complex poles appear naturally in the consistent solution of the factorized BPW equations, and are interpreted according to Lee and Wick as states of indefinite metric. Inclusion of these poles produces considerably closer agreement with experimental results. The Adler–Weinberg consistency condition on pion–nucleon scattering is now satisfied to within 20%, and this is reflected in the near–threshold suppression of the cross sections and amplitudes (nucleon–antinucleon pair suppression). The (3, 3+) resonance is absent in the model. The model is most appropriate for calculating the two–pion contribution to the nucleon–nucleon potential, where subthreshold behavior is more important than the scattering resonances. (auth)

27400 RADIATIVE EFFECTS IN DIFFRACTIVE PION SCATTERING. Sogard, M.R. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850). Phys. Rev. D 11: No. 1, 183-188 (1 Jan 1975).

The radiative tail from the elastic peak, arising from bremsstrahlung in πp scattering, is calculated and shown to have an influence, which can be significant, on the neighboring inelastic spectrum, both in the resonance and diffractive-peak regions. (auth)

27401 RESONANCE MODEL OF BARYONS BASED ON DUALITY AND THE QUARK MODEL. Igi, K.; Shimada, T. (Tokyo Univ.). Lett. Nuovo Cim.; 12: No. 7, 193-198(15 Feb 1975).

An attempt is made to resolve the difficulties of the parity doublets and the ghost problems for baryons simultaneously. A phenomenological model is presented for meson–baryon scattering based on duality and the quark model from the s-channel point of view in the narrow-width approximation. An s-channel Λ-resonance model for $\bar{K}p$ scattering is discussed in the framework of $SU(6_W)$. The predicted values of the elastic widths of Λ resonances are given. (JFP)

27402 MODEL DESCRIPTION OF π^-p ELASTIC SCATTERING AT ALL ANGLES AT 3.92 GeV/c MOMENTUM. Devenski, P. (Higher Inst. of Chemical Tech., Sofia). Yadern. Fiz.; 20: No. 6, 1235-1238(Dec 1964). (In Russian).

The differential cross section for π^-p elastic scattering at 3.92 GeV/c is described in the framework of the model of Chu and Hendry. (3 figures, 1 table) (auth)

27403 INTEGRAL RELATIONS WITH DAMPING FUNCTION FOR FORWARD SCATTERING AMPLITUDE. Agranovskii, B. A. (Inst. of Theoretical Physics, Uzhgorod, USSR). Yadern. Fiz.; 20: No. 6, 1239-1246(Dec 1964). (In Russian).

A number of integral relations with a damping function is obtained for the πN scattering amplitude, which does not contain principal-value integrals, including the relations of the type of superconverging sum rules. Some of them may be used for testing the amplitude analyticity based on the available experimental data with no model assumptions on its asymptotic behavior. Other relations enable one to make certain predictions on the finite-energy and asymptotic behavior of the amplitude. (auth)

27404 SIMPLE DUAL MODEL FOR THE NUCLEON TRAJECTORY CONTRIBUTION TO AXIAL VECTOR CURRENT, NUCLEON → PION, NUCLEON SCATTERING. Csikor, F.; Forgaes, G. (Eotvos Univ., Budapest). Acta Phys. Austr.; 38: No. 4, 336-348(1973).

A simple Veneziano model for the nucleon trajectory contribution to axial vector current, nucleon → (off-shell) pion, nucleon scattering is given. The minimal set of current algebra requirements is established. The model is compatible with these requirements and is free from unphysical singularities. The nucleon isovector form factors are determined. They exhibit reasonable analytic structure without dipole contributions. (auth)

27405 DUALITY STRUCTURE OF DIFFRACTION DISSOCIATION OF MESONS. Hidaka, K. (Tokyo Univ.). Lett. Nuovo Cim.; 12: No. 8, 273-277(22 Feb 1975).

The duality structure is studied in the meson diffraction process $\pi^- + p \to p + X$ by using the $pp \to pX$ data which is related to the studied process through factorization. This brings about a more reliable separation of terms than that obtained directly from the insufficient data on the studied reaction only. The cross sections are discussed. It is concluded that the normal-duality scheme is quite consistent with the experimental data at least at $t = -0.25(GeV/c)^2$ in the meson diffraction dissociation process $\pi^-p \to pX$ as well as the diffraction process $pp \to pX$ including extreme duality is not excluded by the analysis. (JFP)

27406 HADRONS AND THE GENERAL THEORY OF RELATIVITY. Papyrin, A. F. (Dnepropetrov Engineering-Construction Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 144-145 (1974). (In Russian).

Equations are derived to show that by substituting the postulate that in the linear approximation the general theory of relativity is converted into the Newton theory with the postulate that it is converted into the Yukawa theory the Einstein equations can be used to describe the hadron. The use of the formalisms of the general theory of relativity with constant interaction can simulate strongly interacting particles. (JSR)

27407 POLARIZATION TENSORS. II. Gabos, Z. Stud. Univ. Babes-Bolyai, Ser. Phys.; 19: No. 2, 48-52(1974). (In Rumanian).

It is shown that the polarization tensors of the ½ spin particles and the rest mass, other than O, can be expressed by three Stokes vectors — in the pure case. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 27062, 27451, 27462, 27521, 27663, and 27701.

27408 (CONF-730923-, pp 329-338) CORRELATIONS BETWEEN NUCLEONS AND Δ's. Green, A. M.; Haapakoski, P. (Univ. of Helsinki). 1974.

From symposium on correlations in nuclei; Belatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

One can calculate the contribution of the $\Delta(1236)$ to the reaction $n + p \to d + \gamma$ in essentially two ways. In the one advocated in this paper one treats the Δ on the same footing as a nucleon by introducing components containing the Δ explicitly into the nuclear wave function. Electromagnetic and weak processes are then calculated with this modified nuclear wave function. The principal aim of this work is to obtain the form of the Δ component, i.e., its percentage probability (d^2) and spatial dependence. For a better treatment of the $N\Delta$ component, the nucleon–nucleon singlet-even interaction is considered as a coupled-channels problem. (9 figures) (RWR)

27409 (COO-3069-286) BEHAVIOR OF THE PP DIFFRACTIVE CROSS SECTION WITH BOMBARDING ENERGY. Bolon, G. C.; Osborne, L. S. (Massachusetts Inst. of Tech., Cambridge (USA)). 1974. Contract AT(11-1)-3069. 11p. Dep. NTIS $4.00.

High energy proton-proton scattering data were analyzed, and it was found that cross sections for the low multiplicity component and the diffractive component, as measured by nucleon recoil, are consistent with being the same process. These cross sections and the proton recoil spectrum are explained using a core quark exchange model. (auth)

27410 (LA-5854-T) PI-MESON ABSORPTION ON THE DEUTERON. Goplen, B. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 202p. Dep. NTIS $7.60.

Thesis. Submitted to Univ. of New Mexico, Albuquerque.

The treatment of pion absorption on the deuteron covers the Hamiltonian, S-matrix, and optical model formalisms. (JFP)

27411 (LUIP-CR-74-06) MULTIPLICITY CORRELATIONS IN MULTIHADRON REACTIONS. Andersson, B.; Otterlund, I. (Lund Univ. (Sweden). Fysiska Institutionen). Jul 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

Tests of the correlations between the multiplicity distributions stemming from the different encounters between the incoming proton and the nucleons inside the nucleus in high energy proton-nucleus collisions are devised and compared to experimental results. The results show that large correlations must exist between the individual collisions and throw some doubts on the relevancy of a description based upon the individuality of the different encounters. (auth)

27412 (NP-20294-P1, pp vp Paper 6) INCREASING CROSS SECTIONS AND DIFFRACTION. Capella, A. (CERN, Geneva). 1973. (In French).

In summer school on particle physics, Gif-sur-Yvette, France, 24 September–6 October 1973. Volume I.

It is shown that it is possible to connect the two following results obtained at the ISR: the proton-proton total and inelastic cross sections increase by a value of about 10% in the ISR energy range, and the proton spectrum in the $p + p \to p + X$ inclusive reaction exhibits two sharp peaks near to the kinematic region boundaries. The possibility of interpreting the cross section increase in the framework of a perturbative model of strong interactions (Chew and al. model) is examined. (auth)

27413 (SLAC-179(Vol.2), pp 85-106) COHERENT DISSOCIATION OF HADRONS FROM COMPLEX NUCLEI. Gobbi, B. (Northwestern Univ., Evanston, IL). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

A lecture is given on some recent results showing that nuclear diffractive reactions can be used to ascertain the value of the cross section of scattering of unstable particles in nuclear matter. Also the Primakoff effect and direct evidence and applications of the process are discussed. Various distributions and total and differential cross sections for proton, pion, and neutron reactions are discussed. (JFP)

27414 PI-MESIC DECAYS OF A = 4 HYPERNUCLEI. Deloff, A. (Institute of Nuclear Research, Warsaw (Poland)). Nucl. Phys., A; 236: No. 2, 469-490(30 Dec 1974).

Angular distributions and energy spectra for the decay modes ${}^{4}_{\Lambda}\mathrm{He} \rightarrow \pi^- p^3\mathrm{He}$, ${}^{4}_{\Lambda}\mathrm{H} \rightarrow \pi^- p^3\mathrm{H}$, ${}^{4}_{\Lambda}\mathrm{H} \rightarrow \pi^- n^3\mathrm{He}$ are calculated and compared with experiment. Final-state nuclear interactions have been adjusted to fit the corresponding scattering data. With S-, P- and D-wave interactions it was possible to obtain reasonably good agreement with the experimental decay spectra. It is suggested that the ${}^{4}_{\Lambda}\mathrm{H} \rightarrow \pi^- n^3\mathrm{He}$ decay spectra may be decisive in selecting the right set of $p^3\mathrm{H}$ complex phase shifts from several possible solutions. (auth)

27415 THE DOUBLE $\Delta_{33}(1236)$-RESONANCE IN THE DEUTERON. Haapakoski, P.; Saarela, M. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Phys. Lett., B; 53: No. 4, 333-336(23 Dec 1974).

The double $\Delta_{33}(1236)$-resonance admixture in the deuteron is calculated using π-exchange and $\pi + \rho$-exchange transition potentials. It is shown that the ρ-exchange stabilizes the cut off dependence of the transition potential, yielding ~0.5% probability for the resonance with the quark model prediction for the coupling constants. (auth)

27416 PARITY NONCONSERVING NUCLEON–NUCLEON SCATTERING (ONE-BOSON-EXCHANGE) IN THE WEINBERG–SALAM MODEL. Gari, M.; Reid, J. H. (Bochum Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 53: No. 3, 237-240(9 Dec 1974).

In the present paper the implications of the Weinberg–Salam model of weak interactions for parity non-conserving nucleon–nucleon scattering are discussed. The one-boson-exchange nucleon–nucleon potentials are determined by the use of the factorization method and current algebra. The effect of the neutral hadronic currents is to enhance both the pion contribution ($\Delta I = 1$) and the vector meson contributions ($\Delta I = 0,(2)$). The Weinberg–Salam model is consistent with the recent experiment on ${}^{19}\mathrm{F}$ and leads to a sizable measurable polarization effect in the transition 0^-, 0(1.08 MeV) to the ground state of ${}^{18}\mathrm{F}$, namely, $P \sim 5 \times 10^{-3}$. (auth)

27417 INTERPRETATION OF MULTIPLICITY DISTRIBUTIONS. Berger, E. L. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 1, 346-351 (1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Data on multiplicity distribution, mainly in proton-proton interactions at high energy are reviewed. (France)

27418 THEORIES OF THE ABC EFFECT. Barry, G. W. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). Nucl. Phys., B; 85: No. 1, 239-263(20 Jan 1975).

The ABC effect is an enhancement which appears at around 310 MeV in the missing mass spectra of the inclusive reactions: $pn \rightarrow d$, $pd \rightarrow {}^3\mathrm{He}$, and $dd \rightarrow {}^4\mathrm{He}$. For a long time it was regarded as evidence for a low-mass $I = 0$, $J^P = 0^+$ $\pi\pi$ resonance. But such states have never been seen in ordinary hadronic processes, like $\pi N \rightarrow N\pi\pi$. Most of the evidence now points to 3-3 resonance excitation in nuclei as the root cause of the effect. In this paper a number of possible mechanisms are examined. On the basis of explicit calculations which neglect only the spins of the particles it is found that the one-pion exchange model of Risser and Shuster provides a qualitative description of some of the data. The model of Anjos, Levy and Santoro is not substantiated by independent calculation, while the Brody model has little predictive power. A critical review of the various models is presented. (auth)

27419 LARGE TRANSVERSE MOMENTUM PHENOMENA IN A HADRONIC BREMSSTRAHLUNG MODEL. Contogouris, A. P.; Holden, J. P. (McGill Univ., Montreal, Quebec (Canada). Dept. of Physics); Argyres, E. N. (State Univ. Coll., Plattsburgh, N. Y. (USA)). Nucl. Phys., B; 85: No. 1, 102-120(20 Jan 1975).

A bremsstrahlung model is presented which at large transverse momenta p_T leads to an inverse power law for the pion distribution in $pp \rightarrow \pi^{+0} + X$. The model predicts particle yields that increase with energy at fixed p_T (breaking Feynman scaling in a definite way) and provides an understanding of the excess of π^+'s over π^-s, and of the increase with p_T of the associated multiplicity in the direction opposite to the observed pion; it also accounts for proton to π^+ ratios of order 1, but in a parameter-dependent way. The recently observed increase of the mean charged multiplicity in $pp \rightarrow p + \mathrm{MM}$ with the transverse momentum of the projectile is also accounted for. (auth)

27420 ELASTIC AND INELASTIC SCATTERING OF HIGH ENERGY PARTICLES ON THE DEUTERON. Anisovich, V. V.; Dakhno, L. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). Nucl. Phys., B; 85: No. 1, 208-220(20 Jan 1975).

The scattering amplitudes on the deuteron at small momentum transfers are described, taking into account the shadow corrections. In the framework of Regge pole theory, the inelastic shadow corrections are expressed in terms of the amplitudes of inelastic processes. The validity limit of the formulae thus obtained is discussed. (auth)

27421 RAPIDITY CORRELATIONS AT FIXED MULTIPLICITY IN CLUSTER EMISSION MODELS. Berger, E. L. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 85: No. 1, 61-101(20 Jan 1975).

Rapidity correlations in the central region among hadrons produced in proton–proton collisions of fixed final state multiplicity n at NAL and ISR energies are investigated in a two-step framework in which clusters of hadrons are emitted essentially independently, via a multiperipheral-like model, and decay isotropically. For $n \gtrsim \frac{1}{2}\langle n \rangle$, these semi-inclusive distributions are controlled by the reaction mechanism which dominates production in the central region. Thus, data offer cleaner insight into the properties of this mechanism than can be obtained from fully inclusive spectra. A method of experimental analysis is suggested to facilitate the extraction of new dynamical information. It is shown that the n dependence of the magnitude of semi-inclusive correlation functions reflect directly the structure of the internal cluster multiplicity distribution. This conclusion is independent of certain assumptions concerning the form of the single cluster density in rapidity space. (auth)

27422 SEMI-INCLUSIVE SCALING FOR LARGE p_T EVENTS. Finkelstein, J. (Columbia Univ., New York (USA). Dept. of Physics); Kajantie, K. (Helsinki Univ. (Finland). Dept. of Physics). Nucl. Phys., B; 85: No. 2, 517-524(27 Jan 1975).

Semi-inclusive reactions of the type $p + p \rightarrow$ (particle with large p_T) + n charged particles + neutrals are considered, and the following scaling law: $E(d^3\sigma_n/d^3p) = [1/(\sqrt{s})^{\kappa+1}]\, H(2p_T/\sqrt{s}, n/\sqrt{s})$ proposed for the distribution function of the large p_T particle produced in association with n charged particles. This scaling rule is shown to be consistent with present information on single particle spectra and average associated multiplicities at large p_T. Also, it is shown that if the associated multiplicity were to continue to increase linearly with p_T, then moments of the multiplicity distribution would increase like powers of s. (auth)

27423 SELF-CONSISTENT DIFFRACTION IN THE MULTIPERIPHERAL MODEL. IV. Ball, J. S. (Utah Univ., Salt Lake City (USA)); Zachariasen, F. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 85: No. 2, 317-325(27 Jan 1975).

Numerical fits to high energy proton–proton scattering data are made using formulas obtained previously from a self-consistent solution to the multiperipheral model. Agreement with the total cross section and elastic differential cross section is satisfactory. (auth)

27424 BETHE–SALPETER EQUATION FOR J = 0 NUCLEON–NUCLEON SCATTERING WITH ONE-BOSON EXCHANGE. Fleischer, J. (Bielefeld Univ. (F. R. Germany). Abt. Theoretische Physik); Tjon, J. A. (Rijksuniversiteit Utrecht (Netherlands). Instituut voor Theoretische Fysica). Nucl. Phys., B; 84: No. 2, 375-396(13 Jan 1975).

The Bethe-Salpeter equation is solved numerically for the J = 0 nucleon–nucleon phase shifts by iteration and summation of the perturbation series with Padé approximants. As kernel a superposition of π-, η-, ϵ-, δ-, ρ-, and ω-exchange is used, taking completely into account the complications due to the various spin- and positive and negative energy-states. Considerable deviations of phase shifts from the ones as calculated by means of the Blankenbecler-Sugar equation are found. A reasonable reproduction of the ${}^1S_0$ and ${}^3P_0$ phase shifts in the framework of the Bethe–Salpeter equation is obtained by introducing a large ωNN coupling. (auth)

27425 RECENT RESULTS ON NUCLEON DIFFRACTIVE DISSOCIATION. Mukhin, S. V.; Tsarev, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 263-286(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Some recent results on nucleon diffractive dissociation in nucleon-nucleon and nucleon-nuclei collisions at high energy and small momentum transfer are discussed. (auth)

27426 IMPACT PICTURE AND THE RATIO OF ELASTIC TO TOTAL CROSS SECTION AT CERN ISR ENERGIES. Cheng, H. (Department of Mathematics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Walker, J.K.; Wu, T.T. Phys. Rev. D 11: No. 1, 68-72 (1 Jan 1975).

We show that the impact picture of the Pomeron together with ρ and ω exchange account for the shrinkage (antishrinkage) of the elastic forward peak for proton−proton (antiproton−proton) scattering for energies greater than 20 GeV. We predict that the ratio of the elastic to total *pp* cross section rises by 7% in the energy range available at the CERN ISR. (auth)

27427 PRODUCTION OF HEAVY LEPTONS IN PROTON−PROTON COLLISIONS AND THE PARTON MODEL. Chu, G. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Gunion, J.F. Phys. Rev. D 11: No. 1, 73-80 (1 Jan 1975).

Searches for leptons heavier than the muon may be conducted in hadron−hadron collisions: $p + p \rightarrow L^+ + L^- +$ hadrons. We apply the parton model to this process to calculate the correlations and to estimate the cross sections for the decay products of the heavy leptons. (auth)

27428 MECHANISM OF Δ−ISOBAR PRODUCTION IN πd INTERACTIONS AT HIGH ENERGIES. Karmanov, V.A.; Kondratyuk, L.A. (Institute of Theoretical and Experimental Physics). JETP Lett. 20: No. 7, 233-234 (5 Oct 1974).

A mechanism corresponding to backward elastic scattering of a π^- meson by a proton, with subsequent formation of the Δ^- isobar on a neutron, is proposed for the description of the reaction $\pi^-d \rightarrow p\Delta^-$ (1) with forward emission of a fast proton It is shown that $d\sigma_d/du$ for the reaction (1) is proportional in this case to $d\sigma_p/du$ for backward elastic π^-p scattering. (auth)

27429 COMMENT ON DOUBLE−SCATTERING EFFECT IN DEUTERON BREAKUP REACTIONS. Alberi, G. (Istituto di Fisica Teorica dell'Università and Istituto Nazionale di Fisica Nucleare, Trieste, Italy); Rosa, L.P.; Thomé, Z.D. Phys. Rev. Lett. 34: No. 8, 503-506 (24 Feb 1975).

The effect of double scattering on the spectator distribution is re−examined for the process $K^+d \rightarrow K^+\pi^-pp$, integrating over the spectator angles and making a comparison with experimental data. (auth)

27430 BOUND-STATE EFFECT IN DIFFERENCES OF CROSS SECTIONS FOR SCATTERING OF π^- AND π^+ MESONS ON ZERO-ISOSPIN NUCLEI AT HIGH ENERGIES. Kondratyuk, L. A.; Lev, F. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 6, 1179-1189(Dec 1974). (In Russian).

Uncertainties in differences of the total cross sections for π^-d and π^+d interactions due to the deuteron structure are discussed. It is shown that the uncertainty is about 10^{-2} of the radiative corrections to the $\pi^\pm N$ total cross section difference $\Delta\sigma_{\pi N}^{(em)}$ at $E_{l.s.} \gtrsim 100$ GeV; therefore, they cannot be an obstacle in determination of $\Delta\sigma_{\pi N}^{(em)}$ from the difference of the $\pi^\pm d$ scattering total cross sections. Analogous uncertainties in scattering of $\pi^\pm$ mesons on heavier nuclei with isospin 0 are also considered. (12 figures) (auth)

27431 ATTRACTIVE POTENTIAL WITH FORBIDDEN STATES FOR NN INTERACTION. Neudachin, V. G.; Obukhovskii, I. T.; Kukulin, V. I. (Moscow State Univ.). Yadern. Fiz.; 20: No. 6, 1139-1146(Dec 1974). (In Russian).

It is shown that an essential point for a unified description of the phase shifts of the NN elastic scattering at low ($E_{lab} \lesssim 400$ MeV) and high ($E_{lab} \gtrsim 2$ to 3 GeV) energies may be an account of some unphysical states, considered as forbidden by the Pauli principle, in the Levinson theorem. For the singlet-even partial waves a phenomenological attractive potential with a forbidden state is proposed, and for the deuteron the corresponding model function is used. A possible contribution from the forbidden states to elastic and inelastic ed scattering is analyzed. (6 figures) (auth)

27432 PARITY-NONCONSERVING EFFECTS IN n−p CAPTURE AT THERMAL ENERGIES. Lassey, K. R.; McKellar, B. H. J. (Univ. of Melbourne, Parkville, Australia). Aust. J. Phys.; 27: 637-655(Oct 1974).

The circular polarization and asymmetry about the incident neutron spin direction of the photon released in the reaction $n + p \rightarrow d + \gamma$ at thermal neutron energies are consequences of parity violation in the n−p interaction. A formalism is developed which expresses the polarization and asymmetry in terms of the half-off-shell transition matrix, and calculations are performed for several models of the weak parity-nonconserving N−N interaction. The results indicate that the polarization is sensitive to the choice of both the strong N−N interaction and weak N−N interaction while the asymmetry is sensitive mainly to the latter. The observed polarization is of the same sign and rather larger than that calculated with the conventional weak N−N potential. Difficulties in the present method indicate that this discrepancy cannot be regarded as significant. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 27762.

27433 (RLO−2041-120) PROBLEMS WITH THE ACHIMAN MODEL IN THE DEEP INELASTIC REGION. Razmi, M. S. K. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 1974. Contract AT(45-1)-220. 6p. Dep. NTIS $4.00.

It is pointed out that the prediction of a large charge symmetry violation by the Achiman gauge symmetry model also leads to a violation of the positivity condition on the structure function $F_2^{\bar{\nu}N}$. A search for the origins of this inconsistency is made. (auth)

27434 SU(6) AND SUPERSYMMETRY. Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 84: No. 1, 127-131(6 Jan 1975).

It was indicated that supersymmetric theories can support spin-containing symmetries like SU(4) or SU(6) in a manner which is consistent with special relativity and unitarity. The characteristic features of such symmetries are outlined. It appears that these spin-containing symmetries, based as they are on Clifford algebras, exhibit a number of unusual features, and it is not quite clear if they can be identified with Wigner's SU(4) or Gürsey-Radicati-Sakita's SU(6). (auth)

27435 A STRONG CONSTRAINT ON CHIRAL SYMMETRY BREAKING AT SHORT DISTANCES. Broadhurst, D. J. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 85: No. 1, 189-207(20 Jan 1975).

It is shown that if chiral symmetry is broken by a piece of the Hamiltonian density which transforms as a member of a $(3,\bar{3}) + (\bar{3},3)$ multiplet of SU(3) × SU(3) and has scale dimension d, then it is necessary to have $d \geq 3$ to avoid inconsistency with low energy theorems which follow from spontaneous symmetry breaking. This is demonstrated using previously derived inequalities for K_{l3} decay, combined with a detailed analysis of the SU(3) × SU(3) structure of the short-distance expansion for products of current divergences. Asymptotically free gauge theories and some theories with an infrared stable hadronic fixed point can survive this constraint, and for the latter the cross section for e^+e^- annihilation into hadrons should approach its asymptotically scale-invariant behaviour quite slowly. A softened quark-gluon model with d = 3 is excluded. (auth)

27436 SUPERSYMMETRY WITH ISOSPIN. Firth, R. J.; Jenkins, J. D. (Durham Univ. (UK)). Nucl. Phys., B; 85: No. 2, 525-534(27 Jan 1975).

Super-invariant generalizations of the Casimir operators of the Poincaré and isospin algebras are presented. Superfields are discussed, in particular, the simplest irreducible superfields are constructed explicitly, and free and interaction Lagrangians involving them are presented. (auth)

27437 SU(4) EXPLANATION OF THE NARROW RESONANCES IN e^+e^- ANNIHILATION. Boal, D.H.; Graham, R.H.; Moffat, J.W.; O'Donnell, P.J. (Department of Physics, University of Toronto, Toronto, Ontario, Canada). Phys. Rev. Lett. 34: No. 9, 541-543 (3 Mar 1975).

The narrow resonances at $M_\psi = 3.105$ GeV and $M_{\psi'} = 3.695$ GeV are assigned, together with the familiar SU(3) nonet of vector mesons, as members of the $\underline{1} \oplus \underline{15}$ representation of SU(4). This leads to a solution consistent with the observed particle spectrum and accounts for the narrow widths of the ψ and ψ'. The masses of the charmed vector and pseudoscalar mesons are predicted. (auth)

27438 CP NONCONSERVATION AND THE (J,ψ) PARTICLES. Pakvasa, S.; Tuan, S.F. (Department of Physics and Astronomy, University of Hawaii, Honolulu, Hawaii 97822). Phys. Rev. Lett. 34: No. 9, 552-555 (3 Mar 1975).

We consider in a schizon−model framework the suggestion of Nieh, Wu, and Yang that $J^0(3.105)$ [or $\psi^0(3.695)$?] exhibits CP nonconservation. Constraints are delineated for consistency with known CP nonconservation in $K_L^0 \rightarrow 2\pi$. We examine also the consequences of a different avenue for CP nonconservation should the J particles (with pairwise strong interactions to hadrons) be identified with the a particles of Lee. (auth)

27439 GOLDBERGER−TREIMAN RELATION AND CHIRAL−SYMMETRY BREAKING. Jones, H.F. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Scadron, M.D. Phys. Rev. D 11: No. 1, 174-182 (1 Jan 1975).

We review the dispersion−theory calculation of the Goldberger−Treiman discrepancy $\Delta \equiv 1 - mg_A/f_\pi g$. Our estimate is

still some way from the experimental value. The latter and its SU(3) counterparts can be used to determine the chiral–symmetry–breaking parameter c appearing in the $(3, \bar{3}) + (\bar{3}, 3)$ Hamiltonian $u_0 + cu_8$. We find $c \simeq -1$ in agreement with its determination from phenomenological σ terms. (auth)

27440 GAUGE INVARIANCE OF EQUATIONS OF THE RENORMALIZATION GROUP. Kallosh, R. E.; Tyutin, I. V. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 20: No. 6, 1247-1253(Dec 1964). (In Russian).

It is shown that the β function in the asymptotic equations of the renormalization group, as well as the equations for the Green's function of gauge-invariant operators, is gauge independent in non-Abelian gauge theories. (auth)

27441 O(4) ALGEBRA IN RELATIVISTIC PROBLEMS WITH AN ARBITRARY THREE-DIMENSIONAL CENTRAL POTENTIAL. Serebrennikov, V. B. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 20: No. 6, 1254-1261(Dec 1964). (In Russian).

The hidden O(4) symmetry is proposed for solving the relativistic bound-state problem within the quasi-classical accuracy in spin-zero problems. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 27304, 27307, 27548, and 27701.

27442 DIMENSIONAL REGULARIZATION AND FINITE CALCULATIONS IN GAUGE THEORIES. Marciano, W. J. (New York Univ., N. Y. (USA). Dept. of Physics). Nucl. Phys., B; 84: No. 1, 132-140(6 Jan 1975).

The leading finite corrections to a lowest order relation between renormalized coupling constants in an SU(2) × U(1) gauge model of weak and electromagnetic interactions are presented. The calculations were carried out in two different gauge invariant dimensional regularization schemes. A brief outline and comparison of the technical aspects of these methods is given. For this particular calculation it is found that both yield the same finite results as expected. (auth)

27443 SUPERGAUGE SYMMETRY, BROKEN CHIRAL SYMMETRY AND RENORMALIZATION. Tsao, H. S. (Brandeis Univ., Waltham, Mass. (USA). Dept. of Physics). Phys. Lett., B; 53: No. 4, 381-383(23 Dec 1974).

Because of broken chiral invariance the model of Wess and Zumino obeys additional Ward identities. Together with supergauge Ward identities they imply the results of Iliopoulos and Zumino that a single wave function renormalization is sufficient to renormalize the theory. (auth)

27444 CP VIOLATION IN GAUGE THEORIES. Mohapatra, R. N. (Univ. of Maryland, College Park). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 127-141(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

A classification is given of the various models for CP violation in gauge theories. Attention is given to the $K \to 2\pi$ decay, and phenomenology of the K^0–$\bar{K}^0$ system in the presence of CP-violating interactions is summarized. Lastly the dynamical breakdown of CP is considered. (JFP)

27445 COMMENT ON THE $\eta \to 3\pi$ PUZZLE IN THE $(3, \bar{3})$ MODEL. McNamee, P.C. (Departamento de Fisica, Pontificia Universidade Católica, Rio de Janeiro, Brazil); Scadron, M.D. Phys. Rev. D 11: No. 1, 226-229 (1 Jan 1975).

By including a u_3 term in H_{em} and taking into account rapidly varying meson poles, we show that the nonvanishing $\eta \to 3\pi$ amplitude is consistent with pion PCAC and current algebra. In this case, the σ term $\sigma^{+-}{}_{\eta\eta}$ must be substantially larger than that obtained in the Gell–Mann–Oakes–Renner $(3, \bar{3})$ scheme. (auth)

27446 HIGGS–PARTICLE INTERPRETATION OF NARROW e^+e^- RESONANCES. McKay, D.W.; Munczek, H. (Department of Physics and Astronomy, University of Kansas, Lawrence, Kansas 66045). Phys. Rev. Lett. 34: No. 7, 432-435 (17 Feb 1975).

We present a gauge model in which parity and $[SU(2) \otimes Y]_W$ are spontaneously broken. Three neutral Higgs particles couple directly to e^+e^- $(\mu^+\mu^-)$ with coupling strengths proportional to heavy–electron (muon) mass. Identification of two Higgs particles with e^+e^- resonances at 3.105 and 3.695 GeV limits the two heavy–lepton masses to 1–3 GeV. The heavy leptons are not produced by ν_L beams, but have sequential signature in e^+e^- production. (auth)

Applications (Strong)

Refer also to abstracts 27089 and 27352.

27447 (CONF-720923-P3, pp 149-163) HIGHER SYMMETRIES AND BARYON RESONANCES. Rosner, J. L. (Inst. for Advanced Study, Princeton, NJ). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 3.

The calculational rules of $SU(6)_W \times O(2)_L$ are reviewed. Various baryon resonance decays are considered. (JFP)

27448 (COO-1545-150) DEEP INELASTIC DATA AS A TEST OF HADRON SYMMETRIES. Palmer, W. F.; Wada, W. W. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1974. 8p. Dep. NTIS $4.00.

It is proposed that the deep inelastic electron and neutrino scattering data near $x = 0$ provide a way of distinguishing between SU(3) and SU(4) as the fundamental underlying hadron symmetry. (auth)

27449 (DESY-74/63) WIDTH OF ψ(3105). Kitakado, S.; Orito, S.; Walsh, T. F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1974. 6p. Dep. NTIS (US Sales Only) $4.00.

A weakly broken nonet symmetry of the vector mesons is extended to SU(4) so as to include a new $c\bar{c}$ state ψ. From the masses the mixing among ϕ, ω, ψ is determined and thereby $\Gamma(\psi \to$ hadrons) ≈ 60 keV is estimated. The significance of this is discussed for the case of a symmetry as badly broken as SU(4) must be if the new meson at 3.1 GeV is $c\bar{c}$. (auth)

27450 SU(4) × SU(4) SYMMETRY BREAKING AND ITS IMPLICATIONS FOR SU(3) × SU(3) BREAKING. Mott, R. E. (Queen Mary Coll., London (UK)). Nucl. Phys., B; 84: No. 1, 260-268(6 Jan 1975).

Models are investigated where the SU(4) × SU(4) symmetry breaking Hamiltonian, H_{SB}, belongs to the (15,15) and $(10,\bar{10}) + (\bar{10},10)$ representations, and it is shown how they are equivalent to models of SU(3) × SU(3) breaking where H_{SB} belongs to a mixture of different representations. The results for the $\pi\pi$ scattering lengths in the (15,15) model are outside the experimental limits, but the $(10,\bar{10}) + (\bar{10},10)$ model yields solutions with a wide range of values for the scattering lengths within the experimental bounds. (auth)

27451 SCALING IN pp ELASTIC SCATTERING. Collins, P. D. B.; Gault, F. D.; Martin, A. (Durham Univ. (UK)). Nucl. Phys., B; 85: No. 1, 141-157(20 Jan 1975).

Various scaling laws such as $d\sigma/dt \sim s^{-n}f(z)$ are tested against the large $|t|$pp elastic scattering data including that from ISR. The following tentative conclusions are drawn (a) The ISR data are not incompatible with scaling for $|t| > 2.4$ GeV^2. (b) This scaling seems to be a property of the P ⊗ P cut not the P (pomeron) pole. (c) But the power n seems to decrease from about 11.5 at $z = 0$ to 9 or less at $z = 0.99$ (at large s) which could be due to the Landshoff diagram or eikonalisation becoming important, making scaling just a low energy phenomenon. (d) Though f(z) has a fairly simple structure it does not seem to be directly related to the proton's electromagnetic form factor. (auth)

27452 COUNTING HADRON STATES. Dashen, R. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510; Kane, G.L. Phys. Rev. D 11: No. 1, 136-139 (1 Jan 1975).

The question of how to count hadron states is explored. It is suggested that there may be states which should be ignored in classification schemes such as SU(3) or the quark model. (auth)

27453 $(3,\bar{3}) + (\bar{3},3)$ CHIRAL SU(3) × SU(3) SYMMETRY BREAKING AND THE CABIBBO ANGLE. Eliezer, S. (Physics Department, Imperial College, London SW7, England). Phys. Rev. D 11: No. 1, 189-191 (1 Jan 1975).

We consider the implications of a possible common origin for the strong symmetry breaking and the nonconservation of strangeness in weak interactions. Assuming that the strong SU(2) × SU(2) –symmetry–breaking contribution to the pion mass vanishes for a zero Cabibbo angle, then, in order to avoid large strangeness–changing terms, the chiral SU(3) × SU(3) –symmetry–breaking Hamiltonian cannot transform as a pure $(3,\bar{3}) + (\bar{3},3)$ representation. (auth)

27454 VECTOR MESON DOMINANCE AND THE ψ(3105) AND ψ(3700) MESONS. Alles, W. (Univ., Bologna). Lett. Nuovo Cim.; 12: No. 8, 278-280(22 Feb 1975).

The discussion of vector meson dominance and the ψ(3105) and ψ(3700) mesons includes SU′(6) × SU″(3) symmetry, allowed and forbidden decays of these resonances, and the (8 + 1,8) 1^- multiplet. (JFP)

Scattering Theory

Refer also to abstracts 27525 and 27758.

27455 (AD-776527) NON-STATIONARY FORMULATION OF THE NON-RELATIVISTIC N-BODY PROBLEM. Obukhovskii, I. T. Translated from Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; No. 4, 42-51(2 Jan 1974). 13p. (FSTC-HT-23-391-72). NTIS $3.00.

A new generalization of Faddeev's equation is obtained, which is different from Yakubovskii's generalization. The difference is due to utilizing four-dimensional theory instead of three-dimensional theory. An appropriate four-dimensional operator technique is constructed which facilitates the derivation of equations which are similar to the diagram equations of Komarov and Popova. A topological analysis of the amplitudes is made by using structural diagrams. (auth)

27456 (CONF-720923-P1, pp 19-21) NEW METHODS OF ANALYSIS. Cutkosky, R. E. (Carnegie-Mellon Univ., Pittsburgh). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The review of new methods of analysis are concerned with a practical aspect of S-matrix theory, namely the problem of exploiting information about general analyticity properties of the S matrix in analyzing experimental data. Primarily the aspects of the problem of continuing from data given on a branch cut to interior regions of a domain of holomorphy are considered. (JFP)

27457 (CONF-720923-P1, pp 498-503) REGGE CUTS AND REGGEON CALCULUS. 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 1.

The discussion of Regge cuts and Reggeon calculus covers properties of the t-channel, the contribution of four-particle intermediate states to the imaginary part of the $2 \to 2$ amplitude, two-Reggeon unitarity relations, the Gribov–Reggeon calculus, and the Gribov–Migdal rule. (JFP)

27458 (JINR-P2-7483) WKB-APPROXIMATION FOR THE SCATTERING AMPLITUDE ON AN EVEN QUASIPOTENTIAL. Molotkov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 24p. (In Russian). INIS.

The WKB-approximation for the scattering amplitude is investigated for even quasipotentials. A gaussian quasipotential is considered in detail. For this potential it is shown that in the nonrelativistic limit the amplitude has the same asymptote as in the case of potential scattering. At very high energies the amplitude becomes a power function of t: $f(s,t) \sim c(s)t^{-\alpha(s)}$, and this result does not depend on the depth of the quasipotential. (tr-SJR)

27459 (KFKI-75-4) IMPACT PARAMETER STATES AND INFINITE MOMENTUM FRAME KINEMATICS. Huszar, M. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

Timelike representations of the Poincaré group are reduced with respect to the subgroup of transverse Galilei boosts and light front translations. It is shown that the eigenvalues of operators $B_1 = (N_1 + M_2)/(p_0 - p_3)$, $B_2 = (N_2 - M_1)/(p_0 - p_3)$ can be interpreted as a relativistic generalization of the impact parameter. One- and two-particle impact parameter states are introduced and it is shown that the expansion of the scattering amplitude in terms of these states reduces to the familiar impact parameter expansion. It is demonstrated in the front form of mechanics that the quantities B_1, B_2 recover the familiar definition of the impact parameter. (auth)

27460 (SLAC-179(Vol.1), pp 187-288) AMPLITUDE STRUCTURE IN TWO- AND QUASI-TWO-BODY PROCESSES. Davier, M. (Stanford Linear Accelerator Center, CA). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume I.

Lectures are given on the experimental determination of two-body amplitudes and their phenomenology. Interest is focussed on the structure of the amplitudes. The knowledge is translated and summarized in terms of amplitudes. Generalities and complete extraction of amplitudes from data, general features of exchange processes, extracting amplitudes from incomplete data, duality and absorption, and models and speculations. (JFP)

27461 FACTORIZATION OF TWO-PARTICLE T-MATRICES IN THE THREE-BODY PROBLEM. Zubarev, A. L.; Firsov, V. I. (Tashkent State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 37-40(1974). (In Russian).

Factorization of two-particle t-matrices in three-body problems was proposed. From this the scattering phase and half-mass amplitudes were described precisely in any order of approximation. Proof of the equilibrium convergence of the approximation process was given. (tr-auth)

27462 ADDITIVITY OF SCATTERING PHASE SHIFTS. Bajaj, K. K.; Nogami, Y. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 52: No. 24, 2445-2450(15 Dec 1974).

The additivities of the partial wave phase shifts (APP) and of the phase in the impact parameter representation (AIP) are examined for models of scattering from two centers which simulate nucleon–deuteron and pion–deuteron scatterings. It is shown that the AIP, which essentially leads to the Glauber approximation, holds very well, whereas the APP fails except for a trivial case. (auth)

27463 SHADOW POLE CONTRIBUTION TO THE S-MATRIX IN POTENTIAL SCATTERING. Sethia, G.; Gupta, M. C.; Shastry, C. S. (Birla Inst. of Tech. and Science, Pilani, India). J. Phys., A (London); 7: No. 18, 2267-2272(11 Dec 1974).

The contributions of shadow poles to the nonrelativistic S-wave scattering by the exponential and the Hulthen potentials are calculated and the implications of these results in the theory based on shadow poles in particle physics are discussed. (auth)

27464 PARTICLES AND SIMPLE SCATTERING THEORY. Corbett, J. V. (Indiana Univ., Bloomington). J. Math. Phys. (N.Y.); 16: No. 2, 271-274(Feb 1975).

A necessary and sufficient condition for a pair of subspaces to be the in and out scattering subspaces for a simple scattering system is obtained. It involves the existence of certain representations of the Galilean presymmetry group on these subspaces. The physical interpretation is that, in scattering, particles remain as particles even in the presence of the interaction. (auth)

27465 CONSTRUCTION OF SPIN–ORBIT POTENTIALS FROM THE PHASE SHIFTS AT FIXED ENERGY. Hooshyar, M. A. (Pahlavi Univ., Shiraz, Iran). J. Math. Phys. (N.Y.); 16: No. 2, 257-262(Feb 1975).

The nonrelativistic scattering of spin-$\frac{1}{2}$ particles by central and spin–orbit potentials is considered. The form of central and spin–orbit potentials is deduced from a knowledge of the S matrix as a function of angular momentum at a fixed energy. Similar to the case of central potentials, the problem of constructing central and spin–orbit potentials from information on the phase shifts at a fixed energy has an infinity of solutions, depending on an infinite number of parameters. (auth)

27466 AN IMPROVEMENT OF GRIBOV'S REGGEON CALCULUS. Henyey, F. S.; Sukhatme, U. P. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). Nucl. Phys., B; 85: No. 1, 39-49(20 Jan 1975).

An expression is derived for Regge cuts and the associated enhancement of Regge poles, following Gribov's derivation of the reggeon calculus, but refraining from making an approximation made by Gribov. It is shown that Gribov's loop integrand should be multiplied by $[\Delta(t,t_1,t_2)/s_{th}t]^{j+1-\alpha_1-\alpha_2}\{\Gamma(\frac{1}{2})\Gamma(j+2-\alpha_1-\alpha_2)/\Gamma(j+\frac{3}{2}-\alpha_1-\alpha_2)\}$. This factor is identically unity for the Regge cut discontinuity, but is different from unity for enhanced singularities. (auth)

27467 REGGE POLES IN MULTIPARTICLE SCATTERING AMPLITUDES. Swift, A. R. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). Nucl. Phys., B; 84: No. 2, 397-412(13 Jan 1975).

A study is made of the high energy limits of multi-particle scattering amplitudes in a ϕ^3 theory. A limited set of checkerboard diagrams dominate the asymptotic behaviour. The diagrams sum to produce Regge poles. If N is the number of particles bound together, the trajectory functions of the leading Regge poles are given by $\alpha(N) = -(2N-3) + g^2/8\pi^2m^2$. Comparison is made with the generalized multiperipheral model of Auerbach, Aviv, Sugar, and Blankenbecler in which the corresponding trajectories have the form $\alpha(N) = a - bN + cN^2$. (auth)

27468 DYNAMICAL EQUATIONS FOR REGGE THEORY WITH UNITARITY AND CROSSING. Johnson, P. W.; Warnock, R. L. (Illinois Inst. of Tech., Chicago). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 572-574(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Progress made in the construction of two-body scattering amplitudes which satisfy the constraints of unitarity, Mandelstam analyticity, and crossing symmetry, and which exhibit realistic Regge behavior is discussed. (auth)

27469 COMPLEX REGGE POLES. Desai, B.R.; Tsarev, V.A. (Physics Department, University of California, Riverside). Sov. J. Part. Nucl. 5: No. 3, 278-302 (Jan 1975).

The present status of the complex Regge pole model is reviewed. Various dynamic models and certain general considerations that lead to complex Regge poles are discussed. The features of the complex–pole model are considered, and the predictions obtained on its basis are compared with the experimental data. (auth)

27470 MULTIPLE EXCHANGE AND HIGH–ENERGY FIXED–ANGLE SCATTERING. Fishbane, P.M. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901); Simmons, L.M. Jr. Phys. Rev. D 11: No. 1, 150-155 (1 Jan 1975).

We study fermion scattering in both Abelian and non–Abelian field theories in the high–energy fixed–angle limit to fourth order in the coupling, with an eye to the validity of the "one hard, multiple soft" exchange picture (Schiff approximation) and to the possibility of naive or anomalous scaling behavior for the amplitude. We find the Schiff approximation is in error and, if perturbation theory is a guide, that scaling behavior is unlikely. We cannot definitely say whether exponentiation will occur. (auth)

27471 SOLUTION OF THE THREE-DIMENSIONAL LIPPMANN–SCHWINGER EQUATION WITHOUT PARTIAL-WAVE EXPANSION. Belyaev, V. B.; Vzhetsionko, E.; Irgaziev, B. F. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 6, 1267-1272(Dec 1964). (In Russian).

A method to solve the three-dimensional Lippmann–Schwinger equation, applicable to the case of short-range potentials, is presented. The method enables one to solve scattering problems in the region of intermediate and high energies, as well as to describe a motion in a noncentral potential. For the case of scattering on a Gaussian potential the amplitude obtained is compared with those calculated in the Born and eikonal approximations. (auth)

27472 SELF-CONSISTENT RHO-P′ TRAJECTORY FROM THE PLANAR DUAL BOOTSTRAP. Schaap, M. M. (Weizmann Inst. of Science, Rehovot, Israel); Veneziano, G. Lett. Nuovo Cim.; 12: No. 7, 204-206(15 Feb 1975).

By proceeding further in the results of the planar bootstrap theory of previous work, one was able to obtain under some reasonable assumption, a nonlinear integral equation for the exchange degenerate ρ-P′ trajectory $\alpha(t)$. In the region $-0.7 \lesssim \alpha' t \lesssim 0$ it is shown that a linear trajectory of the type $\alpha(t) = 0.6 + \alpha' t$, when used in the equation reproduced itself back within less than 0.05. Also a very reasonable value was obtained for the coupling constant. It is found that provided the reggeon intercept is shifted from the bare-value one to about 0.6 and the coupling is of order one, the dual Born term is amazingly consistent with the planar unitarity constraints. (JFP)

27473 NUMERICAL COMPUTATION OF SCATTERING PHASE SHIFTS FOR A SCREENED COULOMB POTENTIAL. Klozenberg, J. P. (Mullard Research Labs., Reigate, Eng.). J. Phys., A (London); 7: No. 15, 1840-1846(11 Oct 1974).

The theory of the phase equation for elastic scattering with spherical symmetry is applied to the problem of evaluating efficiently the scattering phase shifts in a partial-wave analysis. A Fortran source version of the subroutine is available. (auth)

27474 SUBSIDIARY MINIMUM PRINCIPLES FOR SCATTERING PARAMETERS. Rosenberg, L.; Spruch, L. (New York Univ.). Phys. Rev., A; 10: No. 6, 2002-2015(Dec 1974).

It is denoted as a "primary minimum principle" one in which a quantity B of physical interest is represented as the minimum value with respect to variations in a trial function ψ_t of a functional $F(\psi_t)$; F then provides a variational upper bound on B. (The Rayleigh-Ritz principle for the ground-state energy of a system is a familiar example.) If F is quadratic in ψ_t, the variational property of F enables one to determine the linear parameters relatively easily, but the minimum property is required if the nonlinear parameters are to be determined in a way which allows for systematic improvement of ψ_t. It is shown that for a wide class of problems for which primary minimum principles do not exist, useful and rigorous secondary or "subsidiary minimum principles," are available. That is, one constructs a functional $F'(\psi_t)$ whose minimum value is reached for ψ_t equal to some function ψ of dynamical interest. (The Rayleigh-Ritz method provides a subsidiary minimum principle for the approximate determination of the ground-state wave function of a system.) If $B = B(\psi)$, then a study of $F'(\psi_t)$ provides a powerful tool for the estimation of ψ and therefore B, though $B(\psi_t)$ is not normally a variational bound on $B(\psi)$. Subsidiary minimum principles were recently obtained for the approximation of the auxiliary functions that appear in the variational principle for the matrix element $(\chi_n, W\chi_m)$, where χ_n and χ_m are bound-state wave functions and W is an arbitrary operator. The method is extended to the estimation of matrix elements of the Green's function $g(\epsilon)$ of a bound system with ϵ below the continuum threshold energy. The response of the system to an external perturbation can be represented by matrix elements of this type. While no new results on the bound-state problem are obtained. The formulation is a convenient starting point for the further extension of the method to continuum problems. The new result obtained is the derivation of a subsidiary minimum principle for the problem of scattering of a projectile by a target whose bound-state wave function is only imprecisely known. The subsidiary minimum principle allows for systematic improvement of the closed-channel component of the trial scattering wave function that appears in a Kohn-type variational calculation of the scattering amplitude. (auth)

27475 DISCRETE-BASIS-SET APPROACH TO NONSPHERICAL SCATTERING. II. Rescigno, T. N.; McCurdy, C. W. Jr.; McKoy, V. (California Inst. of Tech., Pasadena). Phys. Rev., A; 10: No. 6, 2240-2245(Dec 1974).

A method is described for computing scattering amplitudes for a cylindrically symmetric potential using square-integrable basis functions. The addition of variational corrections using the Kato formula is also outlined. Results for a two-center Gaussian potential are presented. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

27476 DYNAMIC PROPERTIES OF THE MULTICOMPONENT BOSE FLUID. Halperin, B. I. (Bell Labs., Murray Hill, NJ). Phys. Rev., B; 11: No. 1, 178-190(1 Jan 1975).

The hydrodynamic properties of an m-component Bose fluid are explored, with attention to the consequences of the invariance of the Hamiltonian under the group U(m) of unitary transformations in the component space. It is pointed out that the hydrodvnamics of the multicomponent systems ($m \geq 2$) differs in significant respects from that of the ordinary superfluid ($m = 1$). For example, in the superfluid phase, the multicomponent system has propagating modes with $\omega \propto k^2$ at long wavelengths, similar to the spin wave in a Heisenberg ferromagnet. In the normal phase, the multicomponent system has $m^2 - 1$ new diffusive modes, corresponding to the conserved generators of the group SU(m), whose fluctuations diverge in the critical region. On the basis of dynamic scaling and the mode–mode coupling approach applied to these new modes, a dynamic critical exponent $z = \varphi/\nu$ is predicted, where φ is the cross-over exponent for a symmetry-breaking perturbation of the axial type. (auth)

27477 SUPERFLUID FRACTION NEAR T_λ IN ^{3}He–^{4}He MIXTURES. Uehara, F.; Kobayashi, T.; Tominaga, A.; Narahara, Y. (Tokyo Univ. of Education, Otsuka, Japan). Phys. Lett. 50A: No. 2, 83-84(18 Nov 1974).

The critical exponents $\zeta(X)$ of superfluid fraction ρ_s/ρ in ^{3}He-^{4}He mixtures were determined from the measured second velocity and were found to be almost independent of molar concentration X. (auth)

27478 NEW MECHANISM OF DISSIPATION IN THE ACCELERATED FLOW OF SUPERFLUID HELIUM. Calvani, P.; Greulich, R.; Maraviglia, B. (Univ., Rome). Lett. Nuovo Cim.; 11: No. 12, 575-576(23 Nov 1974).

The comments of Campbell [Lett. Nuovo Cimento, 11, 573 (1974)] on the authors letter [Lett. Nuovo Cimento, 6, 536 (1973)] are answered. (MHR)

27479 NEW MECHANISM OF DISSIPATION IN THE ACCELERATED FLOW OF SUPERFLUID HELIUM. Campbell, L. J. (Los Alamos Scientific Lab., NM). Lett. Nuovo Cim.; 11: No. 12, 573-574(23 Nov 1974).

The recent theory of Calvani, et al. [Lett. Nuovo Cimento, 6, 536(1973)] is discussed critically. Points discussed include the absence of an irreversible element in the theory, the neglect of Anderson's phase condition, and the assumption that polarization occurs for both phonons and rotons. (MHR)

27480 CRITICAL EXPONENTS FOR THE SHEAR VISCOSITY OF ^{4}He AT T_λ. Biskeborn, R.; Guernsey, R.W. Jr. (Columbia Radiation Laboratory, Department of Physics, Columbia University, New York, New York 10027). Phys. Rev. Lett. 34: No. 8, 455-458 (24 Feb 1975).

Precision measurements of the viscosity (η) of liquid ^{4}He at the saturated vapor pressure over the range $2.0 \times 10^{-6} \lesssim |\epsilon| \lesssim 5.5 \times 10^{-3}$ ($\epsilon = T/T_\lambda - 1$) have revealed a singularity of the form $\eta/\eta_\lambda - 1 = -A'(-\epsilon)^{0.65 \pm 0.03}$ below T_λ and $\eta/\eta_\lambda - 1 = A\epsilon^{0.80 \pm 0.05}$ above T_λ. (auth)

27481 THERMAL–EXPANSION COEFFICIENT AND UNIVERSALITY NEAR THE SUPERFLUID TRANSITION OF ^{4}He UNDER PRESSURE. Mueller, K.H.; Pobell, F. (Institut für Festkörperforschung, Kernforschungsanlage Jülich, 517 Jülich, W. Germany); Ahlers, G. Phys. Rev. Lett. 34: No. 9, 513-516 (3 Mar 1975).

High–resolution measurements of the thermal–expansion coefficient of pressurized ^{4}He (5 bar $\leq P \leq$ 29 bar) near T_λ ($2 \times 10^{-5} \lesssim |t| \lesssim 0.07$; $t \equiv T/T_\lambda - 1$) by a new technique yielded a universal (pressure–independent) critical exponent $\alpha = \alpha' = -0.026 \pm 0.004$, a universal amplitude ratio $A/A' = 1.11 \pm 0.02$ for the leading singularity, and a universal ratio $D/D' = 1.27 \pm 0.2$ for the amplitudes of the confluent singularity. These results agree with renormalization–group theory, but are in part contrary to previous experiments. (auth)

27482 NOISE FROM VORTEX–LINE TURBULENCE IN He II. Hoch, H.; Busse, L.; Moss, F. (Department of Physics, University of Missouri at St. Louis, St. Louis, Missouri 63121). Phys. Rev. Lett. 34: No. 7, 384-387 (17 Feb 1975).

The first measurements of fluctuations observed wtih both negative–ion and second–sound probes in turbulent He II are reported. Data on the distributions are well matched by Gaussian functions. An ω^- component, and well–defined relaxation times which depend on the heat flux, are found in the spectral intensity. (auth)

27483 ADSORBED LIQUID LAYERS IN DILUTE LIQUID MIXTURES OF ^{4}He IN ^{3}He. Laheurte, J. P.; Romagnan, J. P. (Laboratoire de Physique de la Matiere Condensee, Nice). Phys. Lett., A; 50A: No. 3, 213-214(2 Dec 1974).

Surface separation is studied through numerical calculations; it is shown that local density measurements should give accurate information. (auth)

27484 VISCOSITY OF SUPERFLUID ^{3}He. Valls, O.; Houghton, A. (Brown Univ., Providence). Phys. Lett., A; 50A: No. 3, 211-212(2 Dec 1974).

The shear viscosity of the axial and isotropic phases of superfluid ^{3}He is calculated assuming a constant mean free path (attributed to diffusive boundary scattering) for the quasi-particles. The results are compared with the experiments of Alvesalo et al. (auth)

27485 MAGNETIC BEHAVIOR OF B PHASE OF SUPERFLUID ^{3}He IN THE NONLINEAR REGIME. Maki, K.; Hu, C. R. (Univ. of Southern California, Los Angeles). J. Low Temp. Phys.; 18: No. 3-4, 377-385(Feb 1975).

Assuming that the B phase of superfluid ^{3}He is described by a spherical triplet state of Balian and Werthamer, the magnetic response of the B phase is formulated in terms of the rotation of the condensate spin axis. In a cylindrical geometry with the axis parallel to an external magnetic field two distinct equilibrium configurations are likely to be realized depending on the field strength. The ringing behavior of the magnetization after a sudden application (or removal) of an external field is considered for these two configurations. These two configurations give rise to different ringing behavior. (auth)

27486 EXACT SELF-CONSISTENT BRUECKNER CALCULATION FOR LIQUID ^{3}He. Ghassib, H. B.; Irvine, J. M. (Univ. of Manchester, Eng.). J. Low Temp. Phys.; 18: No. 3-4, 201-217(Feb 1975).

The Brueckner g-matrix elements for liquid ^{3}He are calculated by a direct matrix inversion method. The validity and convenience of this approach, developed and applied to the nuclear matter problem by Baranger and Tabakin, among others, are here demonstrated for ^{3}He for the first time. Three different Fourier-transformable, two-body potentials are used, including the Frost–Musulin potential of Bruch and McGee. The "exact" self-consistent single-particle energy spectrum is obtained for this potential for several densities, using the first 12 relative partial waves. This spectrum is used to compute the two-body binding energy and as a validity check for the effective-mass approximation, which has been extensively used in liquid ^{3}He calculations. (auth)

27487 EFFECTIVE INTERACTIONS OF ^{3}He QUASIPARTICLES IN DILUTE SOLUTIONS OF ^{3}He IN SUPERFLUID ^{4}He. Baym, G. (Univ. of Illinois, Urbana). J. Low Temp. Phys.; 18: No. 3-4, 335-341(Feb 1975).

The effective interaction at long wavelength is computed of two opposite-spin ^{3}He in superfluid ^{4}He to second order in ^{3}He–^{4}He mass difference perturbation theory. The correction to the Bardeen, Baym, Pines result $V(0) = -\alpha^2 m_4 s^2/n_4$, in second order, is expressed exactly in terms of the dependence of the pure ^{4}He kinetic energy on the ^{4}He mass; this correction turns out to be an order of magnitude smaller than one would at first expect. (auth)

27488 MEASUREMENTS OF THE MELTING CURVE OF ^{3}He BELOW 3 mK. Dundon, J. M.; Goodkind, J. M. (Univ. of California, San Diego). J. Low Temp. Phys.; 18: No. 3-4, 315-319(Feb 1975).

Measurements of the pressure vs. temperature along the melting curve of ^{3}He are presented. Cooling is obtained by adiabatic demagnetization of copper nuclei and these measurements extend below 1 mK. The results support conclusions about the entropy of solid ^{3}He drawn from measurements on the heat capacity of the solid, and confirm the temperature scale inferred from measurements in Pomeranchuk cells. (auth)

27489 NMR PROPERTIES NEAR THE ^{3}He A-NORMAL TRANSITION. Takagi, S. (Univ. of Sussex, Brighton, Eng.). J. Low Temp. Phys.; 18: No. 3-4, 309-314(Feb 1975).

The NMR properties of the A phase of liquid ^{3}He very close

to the transition temperature are investigated on the basis of the Leggett theory and of the assumption that the state is of the Anderson–Brinkman–Morel type. The explicit temperature dependence of the NMR frequencies is obtained and is shown to be quite different from that expected from a simple extrapolation of the lower temperature data. (auth)

27490 MOBILITY OF ELECTRONS ALONG THE LIQUID HELIUM SURFACE IN STRONG RETARDING ELECTRIC FIELDS. Rybalko, A. S.; Kovdrya, Yu. Z. (Inst. of Physics and Tech. of Low Temperatures, Kharkov). J. Low Temp. Phys.; 18: No. 3-4, 219-227(Feb 1975).

The velocity of electrons was measured moving in helium vapor along the liquid–vapor interface in electric fields which were weak in the direction parallel to the surface and strong in the direction perpendicular to the surface. It is shown that in the 1.4 to 2.0 K range in applying retarding fields up to 8000 V/cm, when the electron density is sufficiently large, there is evidence for the existence of slower electrons as compared to those whose mobility is controlled by collisions with He atoms in the vapor phase. The mobility of these slower electrons is relatively temperature independent and decreases with growing electron density and retarding electric field. (auth)

27491 FREQUENCY AND TEMPERATURE DEPENDENCE OF SOUND VELOCITY IN LIQUID HELIUM-4: A TEST OF THE PHONON DISPERSION RELATION. Junker, W. R.; Elbaum, C. (Brown Univ., Providence). Phys. Rev. Lett.; 34: No. 4, 186-189 (27 Jan 1975).

Changes $\Delta C/C$ in sound velocity C in liquid helium-4 over the frequency range 1 to 15 MHz were studied as a function of temperature for $0.45 \geq T \geq 0.1$ K. The experimental results are in qualitative agreement with predictions of positive phonon dispersion for small momentum values. (auth)

Superconductivity

Refer also to abstracts 26316, 26322, 26356, 26372–26375, 26382, 26388, 26391, 26392, 26398, 26404, and 26416.

27492 (AD-785424) STRUCTURE DEPENDENT PROPERTIES OF THIN FILM SUPERCONDUCTORS. Final Report. Dickey, J. M. (City Coll., New York (USA)). Aug 1974. 9p. (AFOSR-TR-74-1377). NTIS $3.00.

The surface properties of superconductors have been studied using low energy electron diffraction and Auger spectroscopy. Thin films of superconducting compounds have been produced by evaporating thin layers of aluminum and tin onto niobium and then annealing at a suitable temperature. The resulting films have a transition temperature approaching that of the bulk compounds. The interaction between niobium and nitrogen has been investigated, and the sticking coefficients measured. N forms an order 5×5 structure. The production of thin skins of a superconducting compound on a substrate of one of the components has been shown to be a viable technique and could have many useful applications. The conditions for growth of the skin are critical and not all compounds could be so formed. (auth)

27493 (AD-785484) INTERMEDIATE STATE IN SUPERCONDUCTORS. Final Report. Farrell, D. E. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Physics). 31 Aug 1974. 10p. (AFOSR-TR-74-1371). NTIS $3.00.

The extensive theoretical and experimental program described in this report has substantially increased our understanding of many aspects of the intermediate state in superconductors. Fundamental areas contributed to include: basic energetics, growth and stability of flux structures, local magnetic fields in the intermediate state, surface energies of zinc, aluminum, and mercury and electrically and thermally induced flux motion. In addition, a related technical investigation of the resistance of normal metal contacts on superconductors holds promise of extensive application to the practical important area of type-II superconductivity. (auth)

27494 (AD-787054) ADVANCED CONCEPTS OF SUPERCONDUCTIVITY: A COMPARATIVE REVIEW OF SOVIET AND AMERICAN RESEARCH. Part I. High Temperature Superconductivity. Ksander, Y.; Singer, S. (Rand Corp., Santa Monica, Calif. (USA)). Jan 1974. 83p. (R-1401-ARPA). NTIS $4.75.

Novel mechanisms for achieving high temperature superconductivity (HTS) are reviewed, the most promising of which is the exciton process. Section 1 summarizes the HTS research programs in the United States and in the USSR, from the publication of the Bardeen-Cooper-Schrieffer theory (1957) in the United States and the Ginzburg-Landau theory (1950) in the USSR, and ending with the present. The introduction also cites examples of known superconductors and their critical temperatures, and it briefly discusses the conventional applications of superconductivity. Comments are made on the tradeoff between cryogenic devices and potential HTS variants. Cautious optimism is expressed toward work on excitonic superconductors currently under way in both countries. HTS technical material is reviewed in sections II and III, which lay groundwork for the assessment of the American and Soviet efforts in the concluding section IV. (GRA)

27495 SUPERCONDUCTIVITY: A MACROSCOPIC QUANTUM-MECHANICS EVENT. Takacs, S. (PFUK, Bratislava). Pokroky Mat. Fyz. Astron.; 19: No. 4, 200-211(1974). (In Slovak).

From conference on problems in modern physics; Bratislava, Czech., May 14-15, 1973 (14 May 1973).

The basis of the property of superconductivity and its microscopic nature are discussed. Manifestations of quantization in superconductivity phenomena are described, and the relation of superconductivity to other fields is considered. Problems in modern studies of superconductivity are presented. (tr-auth)

27496 CALCULATION OF TUNNEL CURRENT DUE TO VORTEX CORE EXCITATIONS IN CLEAN SUPERCONDUCTORS. Band, W. T.; Donaldson, G. B. (Univ. of Lancaster, Eng.). J. Phys., F. (London); 4: No. 11, 2017-2032(Nov 1974).

A calculation is presented of the conductance associated with low lying vortex core excitations in a clean superconducting tunnel junction containing well separated flux vortices whose axes are perpendicular to the insulating barrier. The method combines the Bardeen tunnelling matrix element with the Caroli–Bardeen description of clean limit vortices. Account is taken of the anisotropy of the density of states and of the angular selectivity of the barrier as a function of its thickness and band gap. For a typical case the tunnel conductance between a vortex and a normal metal (VIM) is around one third of that predicted by inserting the vortex density states directly into conventional tunnelling formulae. However, in tunnelling transitions between two vortices (VIV) there is also an angular momentum conservation rule which results in almost zero conductance at low bias. This may account for recent observations that VIM donductances compare well with conventional calculations while VIV conductances are anomalously low. (auth)

27497 EFFECT OF ELECTRON DAMPING ON THE CRITICAL TEMPERATURE OF IDEAL SUPERCONDUCTORS. Medvedev, M. V.; Pyatiletov, Y. S. (Institute of Metal Physics, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.–Solid State 16: No. 7, 1256-1258 (Jan 1975).

A study is made of the effect of damping of electrons, due to their interaction with phonons, on the critical temperature T_c of ideal superconductors. It is shown that an allowance of the damping of electrons with energies higher than the maximum frequency of the phonon spectrum enhances the calculated value of T_c. This is due to the fact that the electron–phonon interaction at frequencies above the maximum phonon frequency leads to an effective repulsion of electrons. The electron damping weakens the effect of such an interaction and, therefore, results in an effective attraction of electrons. (auth)

27498 FLUCTUATION RESISTIVITY OF THIN FILMS OF TYPE II SUPERCONDUCTORS. Chechetkin, V.R. (L. D. Landau Insitute of Theoretical Physics, Academy of Sciences of the USSR, Chernogolovka). Sov. Phys.–Solid State 16: No. 7, 1276-1279 (Jan 1975).

In the presence of a transport current it is possible to have a fluctuation of vortex lines from one side of a film to the other. This process gives rise to a nonzero resistance. The dependence of this resistance on current, external field, sample dimensions, and the presence of pinning centers is determined. Since the activation energy is of the same order of magnitude as the binding energy to the pinning centers, their presence considerably alters the fluctuation resistance. A method for calculating the penetration time through the barriers is presented for the case when the slowest motion is that through a saddle point. (auth)

27499 SEARCH FOR SUPERCONDUCTIVITY IN LAVES PHASE COMPOUNDS. Rapp, O. (Royal Inst. of Tech., Stockholm); Invarsson, J.; Claeson, T. Phys. Lett., A; 50A: No. 3, 159-160(2 Dec 1974).

A search for superconductivity in the Laves phase compounds ZrW_2, HfW_2, $TiCr_2$, $ZrCr_2$, $ZrMo_2$, and $HfMo_2$ is reported. $ZrMo_2$ is found to be superconducting at 0.12 K. Superconductivity in $HfMo_2$ in the cubic phase is reconfirmed while the hexagonal phase is also found to be superconducting at about the same temperature. The other compounds remain normal down to 0.03 K. (auth)

27500 THEORY OF SUPERCONDUCTING ALLOYS. Weinkauf, A.; Zittartz, J. (Univ., Cologne). J. Low Temp. Phys.; 18: No. 3-4, 229-239(Feb 1975).

A theory is presented to describe disordered weak coupling superconductors. It is shown that the disorder problem can be treated completely within the CPA scheme without further approximations. In particular, the theory is applied to the calculation of the superconducting transition temperature as a function of the alloy parameters. (auth)

27501 TRANSITION TEMPERATURE AND ENERGY GAP FOR SUPERCONDUCTORS WITH STRONG COUPLING. Geilikman, B. T.; Kresin, V. Z.; Masharov, N. F. (Moscow State Pedagogical Correspondence Inst.). J. Low Temp. Phys.; 18: No. 3-4, 241-271(Feb 1975).

The ratio of the energy gap $\epsilon(0)$ for T = 0 to the transition temperature T_c, the value of energy gap $\epsilon(T)$ near T_c, and the expression for the transition temperature are calculated within the framework of the strong coupling theory. (auth)

27502 RADIATION AND THE I-V CHARACTERISTIC OF SMALL JOSEPHSON JUNCTIONS. Zilberman, L. A. (Inst. of Physics and Tech., Donetsk, USSR). J. Low Temp. Phys.; 18: No. 3-4, 283-295(Feb 1975).

A calculation of the I-V characteristic and radiation spectrum of small Josephson junctions is given which takes into account the contribution to the tunneling current from the interference term and contributions to the current that are second order in the tunneling probability. The nonlinear dependence of the Josephson current on the phase difference of order parameters of superconducting films is taken into account exactly. The exact solution for the I-V characteristic of the junction is obtained in the form of an operator. Calculations are presented for the case of low junction capacitance. (auth)

27503 COEXISTENCE OF SUPERCONDUCTIVITY AND FERROMAGNETISM IN THE s-d MODEL. Crisan, M.; Jones, H. (Univ. of Geneva). J. Low Temp. Phys.; 18: No. 3-4, 297-307(Feb 1975).

A calculation is presented of the coexistence of superconductivity and ferromagnetism in the s-d model for the case when the exchange interaction between the ferromagnetically aligned d electrons and the conduction electrons is weak and the effects can be considered of the first order. The equations for the order parameter and the polarization of the conduction electrons have been derived using a Green's function method for two limiting cases: (a) a δ-function density of states and (b) a constant density of states. (auth)

27504 SELF-CONSISTENT PAIR POTENTIAL IN SUPERCONDUCTORS. II. Superconductor: Magnetic Insulator Boundary at Low Temperatures. Bar-Sagi, J. (Technion-Israel Inst. of Tech., Haifa). J. Low Temp. Phys.; 18: No. 3-4, 343-354 (Feb 1975).

The self-consistency of the Ginsburg-Landau solution for the pair potential of a semiinfinite superconducting slab in contact with a magnetic insulator is investigated. The calculation is based on solutions of the Bogoliubov-de Gennes equations previously reported. Down to 0.75 T_c, the self-consistency is found to be satisfactory. If the temperature-dependent coherence length $\xi(T)$ is not required to vary as $\Delta_\infty(T)^{-1}$, the domain of self-consistency can be extended to about 0.6 T_c. (auth)

27505 SIZE EFFECTS AND MAGNETIC PARAMETERS OF HARD SUPERCONDUCTORS IN PARALLEL FIELDS. Chizhov, A. Kh.; Stovbur, V. I. (Ioffe Inst. of Physics and Tech., Leningrad). Fiz. Metal. Metalloved.; 38: No. 4, 738-745(Oct 1974). (In Russian).

A study of hollow cylinders made from Pb-Bi alloy with wall thickness, w from 4 to 0.15 mm showed that the size dependence of the magnetic properties of hard superconductors is complex. For samples with $w > w_k$ and $w < w_k$, different size dependences are typical for "breakdown" fields H_p and H_1, the limits of the linear region of the dependence of the reverse magnetization on the average fields in the wall of the sample, the parameters a and B_0, and others. The ratio of the fields H_1/H_p = constant for samples of all sizes and any field in the sample in the range $H_p \leq H \leq H_1$ has the same size dependence. The limitation of the Kim model for samples with $w < w_k$ is shown and new parameters are introduced which remove this limitation. (tr-auth)

27506 SPACE CHANGES IN THE ORDER PARAMETER NEAR A DIAMAGNETIC IMPURITY IN A SUPERCONDUCTOR WITH OVERLAPPING ENERGY BANDS. Gvozdikov, V. M.; Fal'ko, I. I. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 38: No. 4, 696-701(Oct 1974). (In Russian).

Using the equation for Green's matrix function, a system of integral equations was obtained for the order parameter in superconductors with overlapping energy bands. Based on these equations, the problem of space differences in the behavior of the order parameters close to a diamagnetic impurity was considered. (tr-auth)

PHYSICS (NUCLEAR)

Refer also to abstract 27777.

Neutron Interactions with Matter

Refer also to abstract 27681.

27507 (CONF-7209124-, pp 1-74) REQUIREMENTS VERSUS PRESENT STATUS OF EVALUATED NEUTRON NUCLEAR DATA FOR FAST REACTOR DESIGN. Schmidt, J. J. (International Atomic Energy Agency, Vienna). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

In recent years the nuclear technical and scientific community has mounted a global effort in the detailed assessment of data requirements and in the measurement, compilation, and evaluation of the required data. This paper describes the objectives and achievements of this international effort. After some general background is given, the implementation of international cooperation in the field of neutron nuclear data is discussed; this presentation includes RENDA, data production, data compilation and evaluation (definition of terms, CINDA, EXFOR, evaluated data), usage of the data, and meetings. In conclusion, neutron nuclear data requirements and confidence levels achieved are reviewed under the following headings: review of references, accuracy requirements versus achievements for fast reactor design parameters, accuracy requirements versus confidence levels achieved for fast neutron nuclear data, derivation of neutron data accuracy requirements from required accuracies in reactor design parameters, accuracy requirements versus confidence levels achieved for neutron standard reference data, and relationship between standard data and fast reactor parameter accuracies. (12 figures, 9 tables, 109 references) (RWR)

27508 (CONF-7209124-, pp 229-285) ROLE OF INTEGRAL DATA. Farinelli, U. (CNEN, Rome). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

After discussing the drawbacks of the differential and also the integral approaches in data evaluation, the author proposes a global approach in which all available information is taken into account, with appropriate allowance for the characteristics of each type of measurement, accuracies, statistical and possible systematic errors, correlations, normalizations, etc. The paper outlines a general philosophical approach to this problem, and examines how different groups have put this approach into practice in particular fields (fast reactors, thermal reactors, shielding, dosimetry, radiation damage and activation). The section on applications to fast reactors is treated in greatest detail, the following particulars being taken into account: characteristics, a short history of earlier work, the adjustment procedures, experimental programs, use of integral results, and limits of the adjustment procedures. (2 figures, 6 tables) (RWR)

27509 (CONF-7209124-, pp 300-319) NEUTRON CROSS-SECTION EVALUATION IN THE THERMAL ENERGY RANGE. Mateescu, N. (Inst. of Atomic Physics, Bucharest). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

Interest in improving experimental and theoretical knowledge on microscopic nuclear data in the thermal energy range continues. One of the main tasks of the evaluator, of course, is to apply careful tests on the most important cross sections to put them in agreement with measured integral parameters. Some aspects connected with the principal evaluated quantity for thermal neutrons, the scattering law, are discussed. After a brief theoretical treatment, some results concerning the scattering law of moderators are reviewed. Scattering models for light water, heavy water, and graphite are included. (RWR)

27510 (IAE-2273) ACCURACY OF THE FEW-GROUP MICROCONSTANTS FOR TWO UPPER GROUPS IN FOUR-GROUP CALCULATIONS. Pavlovichev, A. M.; Fedulov, M. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 15p. (In Russian). INIS.

An attempt was made to evaluate the accuracy of the macroscopic cross sections (for the two upper groups of a four-group computational system), calculated by use of the few-group system of constants. A comparison was made with macroscopic cross sections calculated with the GRACE program by neutron energy spectra averaging. Divergences greatly affecting the accuracy of the calculation of the criticality coefficient of uniform assemblies were detected. (tr-auth)

27511 (JAERI-M-5793) FINITE ELEMENT METHOD FOR SOLVING NEUTRON TRANSPORT PROBLEMS IN TWO-DIMENSIONAL CYLINDRICAL GEOMETRY. Horikami, K.; Nakahara, Y.; Fujimura, T.; Ohnishi, T. (Japan Atomic Energy Research Inst., Tokai). Jul 1974. 48p. Dep. NTIS (US Sales Only).

Algorithms based on the finite element method have been developed for solving the two-dimensional multi-group neutron transport equation in (r,z) geometry. In the algorithms the finite element method is applied only to the spatial variables in regular torus cells with rectangular cross sections. Angular variables are treated in the discrete ordinate approximation. The formulations in both the continuous and discontinuous methods are performed by making use of the bilinear, cubic and biquadratic Lagrange polynomials, respectively, for the cases of four, eight and nine mesh points per rectangular subregion on the (r,z) plane. The Galerkin scheme is adopted for eliminating the residuals of approximate equations in the continuous and discontinuous methods. The algorithm using the neutron balance equation is also given for the continuous method. (auth)

27512 (JINR-3-7655) SMALL ANGLE NEUTRON SCATTERING STUDY USING THE TIME-OF-FLIGHT METHOD. Gledkikh, I.; Kozlov, Zh. A.; Ostanevich, Yu. M.; Cher, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 11p. (In Russian). INIS.

It was shown that for study of the small-angle scattering of neutrons the time-of-flight method has a series of advantages in comparison with the stationary method of beam monochromatization. A significant improvement was obtained for the basic experimental parameters, resolving capacity, luminosity, and effect/background ratio. The region of instability dimensions available for study was expanded. (tr-auth)

27513 TIME-DEPENDENT ELASTIC MODERATION OF NEUTRONS IN A SLIGHTLY-NON-HOMOGENEOUS HEAVY MEDIUM. Metelkin, E. V.; Trukhanov, G. Ya. At. Energ. (USSR); 37: No. 6, 466-470(Dec 1974). (In Russian).

The effect of slight nonhomogeneity of a medium on the formation of the time-dependent space–energy neutron spectrum in a heavy infinite medium from a pulsed point source is evaluated. (auth)

27514 EFFECT OF RESONANCES ON THE NONSTATIONARY NEUTRON SPECTRUM. Metelkin, E. V.; Trukhanov, G. Ya. Sov. J. At. Energy (Engl. Transl.); 35: No. 3, 831(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 192(Sep 1973). This is a summary of paper No. 687/7142 with full copy held at TIC.

The effect of resonances on the nonstationary spectrum of neutrons in an infinite homogeneous medium from a uniformly distributed instantaneous source is investigated for the simplest model, with resonance structure of the absorption cross section taken into account. Neutron absorption is controlling in the middle region; there is no absorption on either side of this region. The neutron spectrum is determined under the assumption that the moderator nuclei are stationary and that the scattering is spherically symmetric in the c.m.s. It is found that the presence of resonances does not affect the slowing-down time. From the expression for the neutron flux it is clear that this flux has dips in the resonance region and the collision density is a smoothly varying function. The result is generalized to an arbitrary number of sufficiently widely spaced resonances; it is shown that in this case the resulting absorption can be considerable. The final result, taking account of the effect of resonances on the nonstationary neutron energy spectrum for narrow resonances, is obtained by multiplying the nonstationary neutron distribution function calculated in the absence of resonances by the resonance escape probability calculated for the stationary case, taking account of the resonances. (4 figures) (RWR)

27515 ANALOG MONTE CARLO STUDIES OF ELECTRON–PHOTON CASCADES AND THE RESULTANT PRODUCTION AND TRANSPORT OF PHOTONEUTRONS IN FINITE THREE–DIMENSIONAL SYSTEMS. Hansen, E.C.; Bartoletti, C.S.; Daitch, P.B. (Rensselaer Polytechnic Institute, Troy, New York 12181). J. Appl. Phys. 46: No. 3, 1109-1123 (Mar 1975).

A major computer program has been written to perform Monte Carlo studies of electron–photon cascades and the resultant production and

transport of photoneutrons in finite three–dimensional systems. It is programmed in FORTRAN and is explicitly designed to be easily used and extended to yield a fast, adaptable, and versatile computer program that has wide application to problems in solid–state, nuclear, and reactor physics. It combines a simple but accurate procedure for sampling from an arbitrary differential probability distribution with efficient cross–section representations to perform complicated single–particle or many–particle calculations. The calculations of Alsmiller and Moran at ORNL and the experiments of Barber and George at the Stanford High Energy Physics Laboratory have been compared with results of the new computer code. The comparisons indicate that the results of the new Monte Carlo studies are in good agreement with the ORNL calculations of the photoneutron yield in cylindrical targets of Cu, Ta, Pb, and U for a wide variety of target radii and thicknesses for incident electron energies of 34 and 100 MeV. The comparisons also yield good agreement with the Stanford experiments of the photoneutron yield in rectangular targets of Cu, Ta, Pb, and U for a wide variety of target thicknesses for incident electron energies ranging from 10 to 34 MeV. A series of Rensselaer Polytechnic Institute LINAC "bare" target experiments have been analyzed with the Monte Carlo program. The computational studies and the experimental results are in good agreement. In particular, there is excellent agreement on the angular distributions of photoneutrons from the three spherical Pb targets as measured using foil detectors. The calculated results predicted quite faithfully the observed improvement in the angular distributions as the design of the spherical Pb target was modified to obtain a more isotropic distribution. (auth)

27516 A STUDY OF NEUTRON WAVE PROPAGATION THROUGH BERYLLIUM OXIDE ASSEMBLIES. Sobhana, S.; Goyal, I. C.; Ghatak, A. K. (Indian Inst. of Tech., New Delhi. Dept. of Physics). Atomkernenergie; 24: No. 3, 180–182(1974).

In this communication we report the results of a series of calculations based on multigroup diffusion theory, using a simple one-term degenerate kernel, for the neutron wave-propagation problem in a beryllium oxide assembly. The calculations have been compared with available experimental data, and have been found to agree with experiment better than the previously reported calculations. (auth)

27517 THEOREM ON ANISOTROPIC SCATTERING. Inonu, E. (Middle East Technical Univ., Ankara). Transp. Theory Statist. Phys.; 3: No. 2-3, 137-146(1973).

In the realm of one-speed, time-independent neutron transport with constant cross sections, a simple connection is established between the solutions of two problems that differ only by the presence of a δ-distribution (in the forward or backward direction) in the scattering kernel. (auth)

27518 NEUTRON PENETRATION USING THE TRANSFER MATRIX METHOD. Chan, T. C. Ames, IA; Iowa State Univ. (1974). 73p. University Microfilms Order No. 75-3295.

Thesis (Ph. D.).

A computer code was developed for the neutron transfer matrix using the DLC-2/100G cross section data. Legendre polynomial expansions in the angular variable and multigroup energy structure were chosen for the work. Instead of using the neutron angle-energy correlation, Legendre polynomial expansions in the neutron differential scattering cross sections were used which leads to simplification in the calculational procedures. The higher order moments of the point matrix kernel, derived from the plane source, were determined. The neutron angular distributions transmitted through a single layer and multi-layers by a point isotropic source were obtained. Some numerical calculations were performed for sodium and iron layers. Comparisons were made between the present work and published experimental results. (Diss. Abstr. Int., B)

27519 ANALYTIC AND NUMERICAL TRANSPORT TECHNIQUES IN ENERGY-DEPENDENT FAST NEUTRON WAVE AND PULSE PROPAGATION. Swander, J. E. (Gainesville, FL; Univ. of Florida (1974). 160p. University Microfilms Order No. 75-3532.

Thesis (Ph. D.).

Neutron wave and pulse propagation analysis is a natural approach to space-dependent kinetics in subprompt critical media. The principal difference between analysis of fast and thermal systems is treating the slowing-down operator. A formal approach is presented for arbitrary slowing-down operators; the spectrum, eigenfunctions, and adjoint eigenfunctions of the slab-geometry energy-dependent wave transport operator are obtained by using the singular eigenfunction technique. Both multiplying and nonmultiplying media are treated. Fission is modeled by a one-term separable kernel. A major portion of this work is devoted to obtaining the energy-dependent wave transport representation of the transfer matrix method, which provides a formalism for implementing calculations concerning wave and pulse propagation through finite regions such as adjacent slabs of different composition. It is found that, for isotropic scattering, the basic operators of the transfer matrix formalism can be constructed from eigenfunctions of the wave transport operator. This result is general, and is equally applicable to fast and thermal analysis. Finally, the dispersion law expression for a fast multiplying medium is employed to develop an algorithm for computing the discrete eigenfunctions and associated dispersion law for separable and degenerate fission kernels. (RWR)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 27075, 27114, 27410, 27414, 27415, 27429, 27430, 27539, 27552, 27697, 27702, 27709, and 27714.

27520 (RLO–2232-T1-3) TOTAL PION CROSS SECTION MEASUREMENTS. Annual Progress Report, January 1–December 31, 1974. Jakobson, M. J.; Jeppesen, R. H. (Montana Univ., Missoula (USA)). 20 Jan 1975. Contract AT(45-1)-2232. 5p. Dep. NTIS $4.00.

Total cross section measurements are continuing for π^+ and π^- mesons on various nuclei for the pion energy range 25 to 250 MeV. The initial run was made at the low energy pion (LEP) channel of LAMPF in May of 1974. A second run is scheduled for the summer of 1975. Initial targets included D, ^{4}He, ^{6}Li, ^{7}Li, ^{10}B, ^{12}C, ^{13}C, ^{16}O, ^{18}O, Al, ^{40}Ca, ^{44}Ca, ^{48}Ca, Ti, Cu, Sn, Ho and Pb. A DISC counter is used to identify the incident pions for energies above 65 MeV. Time of flight counters with an additional timing signal from the r.f. of the accelerator identifies the incident pions at lower energies. A stack of scintillation counters in conjunction with multiwire proportional counters measures the attenuation of the pions. The helium measurements for the energy range 34 to 150 MeV are complete. Additional data are to be taken for the other targets. (auth)

27521 ON THE (ΔΔ)-COMPONENT OF THE DEUTERON. Arenhoevel, H. (Mainz Univ. (F. R. Germany). Inst. fuer Kernphysik). Phys. Lett., B; 53: No. 3, 224-226(9 Dec 1974).

The (ΔΔ) component of the deuteron is investigated by using π and ρ exchange for the (NN → ΔΔ) transition interaction. The dependence of the strength of the (ΔΔ) component on the type of regularization, the cut-off parameter and the normal deuteron wave functions is discussed. Inclusion of the ρ exchange leads to a weaker dependence on the cut-off parameter and to a smaller (ΔΔ) admixture probability of 0.7 to 1.2 percent, depending on the normal deuteron wave function, for a cut-off parameter $\Lambda = 5$ fm^{-1}. (auth)

27522 BREMSSTRAHLUNG IN THE PROTON–PROTON INTERACTION AT 6.92 MeV. Frois, B.; Irshad, M.; Lamontagne, C. R.; von Moellendorff, U.; Pigeon, R.; Roy, R.; Slobodrian, R. J. (Laval Univ., Quebec City (Canada). Dept. de Physique). Phys. Lett., B; 53: No. 4, 341-343(23 Dec 1974).

Measurements of p–p bremsstrahlung cross sections have been performed by detecting the two final-state protons in coincidence at 37°–37° and 38°–38° in the laboratory system, yielding respectively the following values corrected for noncoplanarity: 1.2 ± 0.5 and 1.7 ± 0.7 μb sr^{-2}, in fair agreement with theoretical values. This appears to resolve a discrepancy existing at low energies between theory and experiment, within the quoted errors. (auth)

27523 ON THE THEORY OF THE ^{2}H(π^-,π^-p)n REACTION. Kolybasov, V. M.; Ksenzov, V. G. (Institute for Theoretical and Experimental Physics, Moscow, USSR). Phys. Lett., B; 53: No. 4, 319-321(23 Dec 1974).

The neutron momentum distribution, the Treiman–Yang angle and the polar angle distributions are calculated for the reaction ^{2}H(π^-,π^-p)n at 1 GeV/c. Besides a simple quasielastic scattering, the nucleon rescattering and the pion double rescattering have been considered. The results are compared with the available data. (auth)

27524 ON THE EXISTENCE OF THE ANOMALY IN THE ^{2}H(d,n) AND ^{2}H(d,p) REACTIONS AT $E_d \approx 100$ keV. Gueckel, F. A. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Physikalisches Inst.); Fick, D. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Physikalisches Inst.; Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Z. Phys.; 271: No. 1, 39-48 (Nov 1974).

All data which refer to the existence of an anomaly in the excitation functions of the reactions ^{2}H(d,n) and ^{2}H(d,p) near $E_d = 100$ keV are discussed. New experimental data for the ^{2}H(d,p) reactions using tensor-polarized deuterons ($90 \leq E_d \leq 190$ keV) are presented. (auth)

27525 R-MATRIX APPROACH TO THE 3-BODY PROBLEM. Gloeckle, W. (Bochum Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Phys.; 271: No. 1, 31-37(Nov 1974).

5 refs.

The asymptotic form of the Faddeev amplitude in coordinate space is derived in various orders. This form and the structure of the Faddeev equations allow, by an R-matrix method, establishment of a set of equations directly for the 3-body on-shell T-matrix elements. The procedure is equally well-suited for local and non-local interactions. (auth)

27526 MUON CAPTURE IN ^{3}He. Phillips, A. C.; Roig, F. (Manchester Univ. (UK)); Ros, J. (Oxford Univ. (UK). Dept. of Theoretical Physics). Nucl. Phys., A; 237: No. 3, 493-506. (20 Jan 1975).

The partial capture rates for $\mu^- + {}^3\text{He} \rightarrow {}^3\text{H} + \nu$, nd + ν and nnp + ν are calculated. The predictions of the impulse approximation and the elementary particle method for the ^{3}Hν channel are compared. When relativistic corrections and meson interaction effects are included, the impulse approximation capture rate agrees with that given by the elementary particle method. The theoretical capture rates obtained using both methods and the PCAC values for the induced pseudoscalar form factors agree with the experimental data, but substantial deviations from the PCAC values cannot be ruled out. The capture rates for the ndν and nnpν channels are calculated using the impulse approximation and the Amado model. With the exception of the result of Wang et al. the limited experimental results on the break-up reactions are in agreement with the theoretical calculations. (auth)

27527 TWO-BODY PHOTODISINTEGRATION OF ^{3}He AND ^{4}He IN THE Δ(1236) REGION. Argan, P. E.; Audit, G.; de Botton, N.; Faure, J. -L.; Laget, J.-M.; Martin, J.; Schuhl, C. G.; Tamas, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Nucl. Phys., A; 237: No. 3, 447-464(20 Jan 1975).

Differential cross sections for the reactions ^{3}He(γ,p)d and ^{4}He(γ,p)t were measured at proton c.m. angles of 60° and 90° for photon energies ranging from 150-450 MeV with an average resolution of 8 MeV. Bremsstrahlung was used as the photon source; deuterons/tritons were analyzed in a magnetic spectrometer, whereas coincident protons were detected in a plastic scintillator telescope. The experimental method includes a calibration by means of ^{1}H(γ,π^0)p differential cross section measurement at 90° c.m. in the same photon energy range. The ^{3}He and ^{4}He two-body photodisintegration differential cross sections show a monotonically decreasing variation with photon energy. In addition, partial data on the differential cross section of the reaction ^{4}He (γ,n)τ at 90° and 120° neutron c.m. angle are given. (auth)

27528 ^{2}H(p, 2p) n CROSS SECTIONS FOR CONSTANT NN RELATIVE ENERGIES. McDonald, A.M.; Bonbright, D.I.; van Oers, W.T.H.; Watson, J.W. (Cyclotron Laboratory, Department of Physics, University of Manitoba, Winnipeg, Manitoba, Canada); Rogers, J.G.; Cameron, J.M.; Soukup, J.; Kloet, W.M.; Tjon, J.A. Phys. Rev. Lett. 34: No. 8, 488-491 (24 Feb 1975).

Measurements and various s-wave model calculations of $p+d$ breakup cross sections were made along constant-relative-energy loci as suggested by Jain, Rogers, and Saylor. The measurements utilized special gas scattering apparatus to accurately measure cross sections in the vicinity of destructive interference minima. The data agreed with the most realistic of the models used except at the position of the interference minimum, where a discrepancy of a factor of 3 was found. (auth)

27529 THE VERTEX CONSTANTS OF THE α PARTICLE. Baryshnikov, A.G.; Blokhintsev, L.D.; Narodetskii, I.M. (Institute of Theoretical and Experimental Physics). JETP Lett. 20: No. 7, 235-237 (5 Oct 1974).

The vertex constants for the virtual decays $\alpha \rightarrow T+N$ and $\alpha \rightarrow d+d$ are calculated by solving the integral equations for four nucleons. The vertex constants in a model with separable spin-dependent Yamaguchi potential are $G^2_{\alpha TN} = 17.5 \pm 0.9$ F and $G^2_{\alpha dd} = 36.7 \pm 16.7$ F. (auth)

27530 COULOMB ENERGY OF ^{3}He. Zankel, H. (Univ., Graz); Fayard, C.; Lamot, G. H. Lett. Nuovo Cim.; 12: No. 7, 221-224(15 Feb 1975).

Numerical results for the Coulomb energy of ^{3}He are presented. The emphasis is placed on a careful handling of the Coulomb force in the p-p subsystem of ^{3}He. Since restriction is made to S wave two-nucleon interactions, the Coulomb force acts only in the S_0 p-p state. Using a simple Yamaguchi ansatz for the nuclear interaction, the Coulomb modification of the form factor can be evaluated analytically. (JFP)

27531 SEARCH FOR RESONANCE IN THREE-NEUTRON SYSTEM. Badalyan, A. M.; Birger, E. S.; Konyukhova, N. B. (Inst. of Experimental and Theoretical Physics, Moscow). Yadern. Fiz.; 20: No. 6, 1147-1154(Dec 1974). (In Russian).

For two different shapes of the NN interaction, the square-well potential with large radius and the zero-range interaction, it is shown that there is no low-energy resonance in the three-neutron system at E > 0. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 27094, 27111, 27115, 27129, 27416, 27430, 27520, 27565, 27566, 27569, 27570, 27601, 27696, 27697, 27701, 27702, 27712-27714, 27722, 27730, 27739, 27748, 27749, 27772, and 27791.

27532 (ORNL-TM-4791) OPERATING INSTRUCTIONS FOR THE HEAVY-ION CODE HIC-1. Santoro, R. T.; Bertini, H. W.; Gabriel, T. A.; Larson, N. M.; Hermann, O. W. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 56p. Dep. NTIS $6.00.

The heavy-ion code HIC-1 is a Monte Carlo code that calculates continuum-state transitions between projectile and target in heavy-ion reactions at energies $\gtrsim$ 50 MeV/nucleon. The underlying assumption in the model is that the reaction can be represented as the interaction of two Fermi gases that pass through each other. During the passage of the projectile through the target, those individual nucleons of the projectile that are in the region of overlap undergo quasi-free reactions with the nucleons of the target. The calculation is carried out up to the point of gamma-ray emission, but it does not include this process. This version of the code is a preliminary version only. A brief description of the organization of the code and of the preparation of data is given. The input requirements and programming options of the code are discussed, and a sample problem illustrating the input requirements and the resulting output is given. (13 figures, 2 tables) (RWR)

27533 QUADRUPOLE MOMENT OF THE β-EMITTER ^{17}F. Minamisono, T.; Nojiri, Y.; Mizobuchi, A.; Sugimoto, K. (Osaka Univ., Toyonaka (Japan). Lab. of Nuclear Studies). Nucl. Phys., A; 236: No. 2, 416-422(30 Dec 1974).

The quadrupole effect in the NMR of ^{17}F($I^\pi = 5/2^+$, $T_{\frac{1}{2}} = 66$s) in a MgF_2 single crystal has been investigated. Production and implantation of polarized ^{17}F through the ^{16}O(d,n) reaction and the resulting asymmetric β-decay were utilized. The quadrupole coupling constant is determined to be $|eqQ/h| = 8.41 \pm 0.24$ MHz with $\eta = 0.32 \pm 0.02$ at room temperature. No appreciable temperature dependence of eqQ is found from 77 K up to 770 K by using previously known results, the following ratios of the quadrupole moments are obtained; $|Q(^{17}\text{F},5/2^+)| : |Q(^{18}\text{F}^*,5^+)| : |Q(^{19}\text{F}^*, 5/2^+)| : |Q(^{20}\text{F},2^+)| = 1 : (1.33 \pm 0.08) : (1.24 \pm 0.06) : (0.69 \pm 0.02)$. The additivity relation of Q between ^{17}F, ^{17}O, and ^{18}F* is discussed. (auth)

27534 A STUDY OF THE HIGHER EXCITED STATES OF ^{10}Be FROM THE ^{9}Be(d,p)^{10}Be REACTION. Anderson, R. E.; Kraushaar, J. J.; Rickey, M. E.; Zimmerman, W. R. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). Nucl. Phys., A; 236: No. 1, 77-89(23 Dec 1974).

The levels of ^{10}Be have been studied using the ^{9}Be(d,p)^{10}Be reaction and 17.3-MeV deuterons. The existence of levels at 10.57 and 11.76 MeV has been confirmed, and widths of 150, 291 and 121 keV have been obtained for the levels at 9.27, 9.4 and 11.76 MeV. Angular distributions have been obtained for the ground state and 3.368-, 5.958-, 6.263-, 7.371-, 7.542- and 11.76-MeV levels, and the results were compared to DWBA calculations. The spectroscopic factors that were extracted were found to be appreciably less than those predicted by Cohen and Kurath. The effects of coupling in the channel involving the inelastic excitation of the 2.43-MeV state in ^{9}Be were found to be appreciable. Comparisons are drawn between the ^{9}Be(d,p)^{10}Be and ^{9}Be(p,π^+)^{10}Be reactions. (auth)

27535 EXPERIMENTAL AND THEORETICAL STUDIES OF THE ELASTIC SCATTERING OF POLARIZED NEUTRONS FROM ^{6}Li. Holt, R. J.; Firk, F. W. K.; Hickey, G. T.; Nath, R. (Yale Univ., New Haven, Conn. (USA). Electron Accelerator Lab.). Nucl. Phys., A; 237: No. 1, 111-124(6 Jan 1975).

The analyzing power of ^{6}Li for neutron scattering has been measured throughout the energy range 2-5 MeV and at four angles between 40° and 150°. The polarization of the neutron beam was absolutely determined using a neutron double-scattering method. The analyzing power of ^{6}Li was found to be remarkably constant in energy for all measured angles. A multi-level R-matrix analysis was performed of the analyzing power measurements. The $P_{\frac{1}{2}}$ state located at 3.5 MeV was found to have a

width of 7.3 MeV, and an $s_{\frac{1}{2}}$ state at 2.8 MeV, a neutron width of 3.5 MeV. (auth)

27536 A STUDY OF THE NUCLEAR CONTINUUM IN ^{16}O BY INELASTIC ^{3}He SCATTERING. Moalem, A.; Benenson, W.; Crawley, G. M. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Nucl. Phys., A; 236: No. 2, 307-316(30 Dec 1974).

Inelastic scattering of 71-MeV ^{3}He particles from ^{16}O shows an enhancement and structure of the continuum consistent with the assumption of a giant quadrupole resonance. Completely microscopic model calculations indicate that the excitation of $1^{-}(T = 1)$ and $0^{+}(T = 0)$ states may account for only about 10% of the total cross sections of the excitation region 17–27 MeV. (auth)

27537 A STUDY OF THE EFFECTIVE INTERACTION BY THE $^{15}N(^{3}He,t)^{15}O$ REACTION AT INCIDENT ENERGIES BETWEEN 16.5 AND 37.7 MeV. Pignanelli, M.; Resmini, F.; Fabrici, E. (Milan Univ. (Italy). Istituto di Scienze Fisiche); Escudie, J. L.; Terrien, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Nucl. Phys., A; 237: No. 1, 64-82(6 Jan 1975).

Angular distributions for six triton groups, produced in the $^{15}N(^{3}He,t)^{15}O$ reaction, have been studied in the incident energy range 16.5–37.7 MeV. Data on ^{3}He elastic and inelastic scattering have also been collected. Optical model parameters have been deduced; the ambiguities in the geometries, strengths and in the energy dependence seem to be correlated. Macroscopic calculations give a satisfactory description to the isobaric analog state transition by using a complex symmetry potential; a large energy dependence of the surface imaginary term is required. A microscopic analysis is also given. Evidence for the need of a tensor term in the effective interaction has been found. The energy dependence, of exponential type, seems to be similar for all the isospin-dependent terms of the microscopic effective interaction. (auth)

27538 THE $^{9}Be(\alpha,d)^{11}B$ REACTION AT $E_{\alpha} = 27$ MeV. Puigh, R. J.; Kemper, K. W.; Moore, G. E.; White, R. L. (Florida State Univ., Tallahassee (USA). Dept. of Physics). Nucl. Phys., A; 237: No. 1, 1-10(6 Jan 1975).

Angular distributions have been measured at $E_{\alpha} = 27$ MeV for the $^{9}Be(\alpha,d)$ reaction to the first seven states in ^{11}B for the angular range 7.5°–120° c.m. Excitation curves have been measured in the energy range from 26.5 to 27.5 MeV in 100 keV steps at the lab angles 40°, 60° and 90°. No evidence for non-direct processes was observed. DWBA calculations with Cohen–Kurath spectroscopic amplitudes were moderately successful in describing the transitions to the 0, 2.12 and 5.02 MeV states. The transition to the 4.44 MeV state did not exhibit a stripping pattern and is characteristic of multi-step transitions. (auth)

27539 $^{7}Li + ^{7}Li$ REACTION STUDIES LEADING TO MULTI-NEUTRON FINAL STATES. Cerny, J.; Weisenmiller, R. B.; Jelley, N. A.; Wilcox, K. H.; Wozniak, G. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Phys. Lett., B; 53: No. 3, 247-249(9 Dec 1974).

Boron and carbon reaction products have been observed in the bombardment of ^{7}Li by 79.6-MeV ^{7}Li. Comparisons of the $^{7}Li(^{7}Li,^{11}B)t$ and $^{7}Li(^{7}Li,^{11}C)3n$ channels and a study of the $^{7}Li(^{7}Li,^{10}C)4n$ reaction are presented. (auth)

27540 ON THE INELASTIC EXCITATION OF 2^{-} STATE OF ^{16}O BY α PARTICLES. Mori, A. (Numazu Technical Coll., Shizuoka (Japan)). Phys. Lett., B; 53: No. 3, 234-236(9 Dec 1974).

The excitation of the unnatural-parity state (2^{-},8.87 MeV) of ^{16}O by inelastic scattering of 40-MeV α particle is investigated microscopically. The two-step excitation mechanism via the 3^{-} state at 6.13 MeV is found to reproduce the magnitude of the measured cross section of the 2^{-} excitation. The α–nucleon interaction used for the 2^{-} excitation also reproduces the 3^{-} excitation. (auth)

27541 DWBA ANALYSIS OF POLARIZATION OF PROTONS FROM THE $^{12}C(d,p_0)^{13}C$ REACTION IN THE DEUTERON ENERGY RANGE 4.20 TO 5.40 MeV. Bondouk, I. I. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Nuclear Physics). Atomkernenergie; 24: No. 3, 199-200(1974).

1 fig.; 1 tab.; 7 refs.

The polarization of protons from the $^{12}C(d,p_0)^{13}C$ reaction has been analyzed in terms of the DWBA theory in the deuteron energy range 4.20 to 5.40 MeV. (auth)

27542 DWBA ANALYSIS OF THE ANGULAR DISTRIBUTION AND THE POLARIZATION OF NEUTRONS FROM THE REACTION $^{12}C(d,n_0)^{13}N$ IN THE DEUTERON ENERGY RANGE 2.8 TO 6.2 MeV. Bondouk, I. I. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Nuclear Physics). Atomkernenergie; 24: No. 3, 201-202 (1974).

3 figs.; 1 tab.; 15 refs.

The angular distribution and the polarization of neutrons from the reaction $^{12}C(d,n_0)^{13}N$ in the deuteron energy range 2.8 to 6.2 MeV have been analyzed in terms of the DWBA theory. (auth)

27543 3α DECAY OF THE 10.84 AND 11.83 MeV STATES OF ^{12}C. Antolkovic, B.; Hudomalj, J. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). Nucl. Phys., A; 237: No. 2, 253-259 (13 Jan 1975).

The theoretical density distributions for the $^{12}C-3\alpha$ break-up have been compared with those obtained experimentally for the 10.84- and 11.83-MeV states of ^{12}C. The spin and parity assignment of the 11.83-MeV state of ^{12}C has been deduced from the analysis of data. (auth)

27544 THE VARIATIONAL APPROACH TO THE DENSITY MATRIX FOR LIGHT NUCLEI. Mihailovic, M. V.; Rosina, M. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Nucl. Phys., A; 237: No. 2, 221-228(13 Jan 1975).

A previously introduced variational method for density matrices is adapted for applications in light nuclei. In this method the $E = \Sigma H_{ijkl}\rho_{ijkl}$ is minimized using the two-body density matrix elements $\rho_{ijkl} = \langle\Psi|a_j^{\dagger} + a_i^{\dagger} + a_{kl}|\Psi\rangle$ as variational parameters. As the approximation, a subset of necessary conditions on the two-body density matrix is satisfied: the non-negativity of the two-body density matrix, the non-negativity of the two-hole density matrix $Q_{ijkl} = \rho_{ijkl} - \delta_{ik}\rho_{jl} + \delta_{il}\rho_{jk} - \delta_{jl}\rho_{ik} + \delta_{jk}\rho_{il} + \delta_{ik}\delta_{jl} - \delta_{il}\delta_{jk}$ and the non-negativity of the particle–hole matrix $G_{ijkl} = -\rho_{kjil} + \delta_{ik}\rho_{jl}$. The method is applied to the ground states of the nuclei ^{15}O, ^{16}O, ^{17}O and ^{18}O using the model space spanned by the $1p_{\frac{1}{2}}$, $1d_{\frac{5}{2}}$, $2s_{\frac{1}{2}}$ subshells and of the nuclei ^{20}Ne, ^{24}Mg and ^{28}Si using the model space spanned by the 1d, 2s shell. The comparison of the ground-state energy with the results of the complete diagonalization in the same model space is encouraging. (auth)

27545 $(^{16}O,np)$ AND $(^{16}O,n\alpha)$ REACTIONS ON SOME LIGHT NUCLEI. Valkovic, V.; Liebert, R. B.; Philips, G. C. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.). Nucl. Instrum. Methods; 122: No. 3, 533-542(15 Dec 1974).

Neutron–proton and neutron–alpha particle coincidence events resulting from the 30- and 36-MeV ^{16}O bombardment of ^{9}Be, ^{12}C, and ^{13}C targets were measured. From the distribution of events in the energy–time-of-flight plane the missing mass spectra for the residual nuclei have been constructed for each reaction. The analysis of the $^{12}C(^{16}O,np)^{26}Al$ reaction indicates the emission of correlated neutron–proton pairs in the T = 1 state. (auth)

27546 THE NEUTRON-INDUCED $^{12}C(n,n')3\alpha$ REACTION AT 14.4 MeV IN A KINEMATICALLY COMPLETE EXPERIMENT. Antolkovic, B.; Dolenec, Z. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). Nucl. Phys., A; 237: No. 2, 235-252(13 Jan 1975).

A three-particle coincidence measurement of the $n + ^{12}C \rightarrow n + 3\alpha$ reaction at $E_n = 14.4$ MeV has been performed. The reaction proceeds via several sequential decay processes. The inelastic scattering of the incoming neutron on ^{12}C and the subsequent 3α decay of the 9.36-, 10.84-, 11.83-, and 12.71-MeV excited states of ^{12}C amounts to 90% of the total yield. 10% of the total cross section is attributed to the $^{12}C(n,\alpha)^{9}Be(n,2\alpha)$ reaction proceeding through an intermediate ^{9}Be state at 2.43 MeV. The density distributions of 3α correlation spectra are consistent with I^{π} assignments 3^{-}, 1^{-}, and 1^{+} anticipated for the 9.36-, 10.84-, and 12.71-MeV states of ^{12}C, respectively. However, for the 11.83-MeV state of ^{12}C the spin and parity value 1^{-} is suggested. (auth)

27547 PION–CARBON SCATTERING IN THE α-PARTICLE MODEL. Germond, J. F. (Neuchatel Univ. (Switzerland). Inst. de Physique); Wilkin, C. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., A; 237: No. 3, 477-492(20 Jan 1975).

Elastic $\pi-^{12}C$ scattering in the region of the first pion–nucleon resonance is calculated within Glauber theory on the basis of the naive α-particle model. The input $\pi-\alpha$ scattering amplitudes are obtained from new measurements by an analysis dependent primarily on the nearby zeros of these amplitudes and the form factors of the nuclear model parametrized so as to give good behavior at large momentum transfer. Agreement with experiment seems to get better with increasing energy, and the calculation makes clearer some of the limitations of using this scattering theory for very low energies. (auth)

27548 PARITY MIXING IN ^{19}F. Adelberger, E.G.; Swanson, H.E.; Cooper, M.D.; Tape, J.W.; Trainor, T.A. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. Lett. 34: No. 7, 402-405 (17 Feb 1975).

The parity-nonconserving asymmetry of the 110-keV de-excitation radiation emitted by a polarized ensemble of ^{19}F nuclei in the first excited state is found to be $\delta = -(1.8 \pm 0.9) \times 10^{-4}$. (auth)

27549 FINAL-STATE INTERACTION IN THE REACTION $^6Li(d,tp)^4He$. Kohmoto, S. (Laboratoire de Physique Nucléaire et d'Instrumentation Nucléaire, Centre de Recherches Nucléaires et Université Louis Pasteur, Strasbourg, France); Sakamoto, Y. Phys. Rev. Lett. 34: No. 9, 550-552 (3 Mar 1975).

The recoil-momentum dependence of the shift of the minimum in the angular distributions for the reaction $^6Li(d,tp)^4He$ around 28 MeV is explained by effects due to the final-state interaction between the outgoing proton and the residual ^4He nucleus. (auth)

27550 DIRECT MEASUREMENTS OF THE SIGN OF THE DEFORMATION OF NUCLEI BY THE BLAIR PHASE-SHIFT METHOD. Pavlova, N.N.; Yushkov, A.V. (Institute of Nuclear Physics, Kazakh Academy of Sciences). JETP Lett. 20: No. 7, 228-229 (5 Oct 1974).

The surface shapes of the nuclei ^{12}C and ^{24}Mg were measured, for the first time, by determining the deviations from the Blair phase rule in inelastic scattering of α particles. (auth)

27551 THE ^9Be PHOTONEUTRON CROSS SECTION FROM 17 TO 25 MeV. Kneissl, U.; Kuhl, G.; Leister, K. H.; Weller, A. (Giessen Univ. (F. R. Germany). Inst. fuer Kernphysik). Z. Naturforsch., a; 29: No. 11, 1688-1689(Nov 1974).

We measured the ^9Be photoneutron production cross section $\sigma(\gamma,Tn) = \sigma(\gamma,n) + 2\sigma(\gamma,2n) + \sigma(\gamma,pn)$ in the energy range from 17-25 MeV with quasimonoenergetic photons from positron annihilation in flight. In contrast to experiments of Thomas, Crawford and Thies (1972) and Hughes (1973), performed with bremsstrahlung photon sources, we found no pronounced structure in this energy range. (auth)

27552 EXPERIMENTAL INVESTIGATION OF CUMULATIVE MESON PRODUCTION. Baldin, A. M.; Giordenesku, N.; Zubarev, V. N.; Ivanova, L. K.; Moroz, N. S.; Povtoreiko, A. A.; Radomanov, V. B.; Stavinskii, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 6, 1201-1213(Dec 1974). (In Russian).

The energy spectra of mesons produced at 180° by 6- and 8.4-GeV/c protons on the nuclei D, C, Al, Cu, and Pb were measured. It is shown that, in the antilaboratory system, those reactions correspond to collisions of relativistic nuclei with protons in which the energy transferred to the produced mesons exceeds by up to 4 times the energy per nucleon of the relativistic nucleus. The observed cumulative effect is described by simple relations up to the fourth order. (7 figures, 5 tables) (auth)

27553 DETERMINATION OF THE LIFETIME OF THE 478-keV LEVEL OF $^7Li^*$ FROM THE DOPPLER EFFECT USING A Ge(Li) SPECTROMETER. Ivanov, V. A.; Ignatenko, K. I.; Somikov, A. V.; Stavnivenko, B. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 5, 605-608(1974). (In Russian).

The lifetime of the first excited level of ^7Li from the reaction $^{10}B(n,\alpha)^7Li^*$ was measured using a Pu-α-Be neutron source and a Ge(Li) spectrometer for the detection of the γ radiation. The experimental conditions are described in detail and the methods used to eliminate the ^{239}Pu γ lines and background lines were reported. A value of 1.4×10^{-13} sec was obtained for the lifetime of the 478-keV level, in good agreement with previous results. (JSR)

27554 INELASTIC SCATTERING OF π^+ BY ^{16}O. Iazzi, F. (Istituto di Fisica Sperimentale del Politecnico, Turin); Minetti, B.; Bressani, T. Lett. Nuovo Cim.; 12: No. 7, 199-203(15 Feb 1975).

A previous method using the impulse approximation and the Chew-Low Hamiltonian was used to evaluate the differential cross section for the $\pi^+ + {}^{16}O \rightarrow {}^{16}O^* + \pi$ reaction at 385 MeV/c. Also the spin, parities, and excitation energies of T = 1 intermediate states in ^{16}O and cross sections for their excitation in the studied reaction are given. (JFP)

27555 CHANNELS OF THE REACTION $^7Li(\gamma,p)^6He$. Denisov, V. P.; Chubukov, I. Ya. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 20: No. 6, 1106-1112(Dec 1974). (In Russian).

Energy distributions of photoprotons from ^7Li at 40 values of the maximal bremsstrahlung energy, $E_{\gamma m}$, were measured with the step $\Delta E_{\gamma m} \approx 1$ MeV up from $E_{\gamma m} = 15.5$ MeV. Analysis of these distributions establishes that the final nucleus ^6He may be produced with excitation energies up to ~17 MeV. Besides the detected transitions to the ground state and to the first excited state (1.8 MeV) of the nucleus ^6He, there are some indications that the transitions proceed also to levels (or groups of levels) with energies 2.5 and 8.5 MeV, unknown previously. The partial cross sections of the reaction (γ,p) with production of ^6He are obtained by means of the isochromate method. (auth)

27556 $(\gamma,2p3n)$ REACTION IN LIGHT NUCLEI AT INTERMEDIATE ENERGY. di Napoli, V.; Terranova, M. I. (Univ., Rome). J. Inorg. Nucl. Chem.; 36: No. 12, 3633-3637(Dec 1974).

Aluminium, sodium oxalate, water and polyethylene targets have been irradiated with bremsstrahlung beams at energies between 0.3 GeV and 1 GeV and the cross sections of the $(\gamma, 2p\ 3n)$ reaction have been measured for ^{27}Al, ^{23}Na, ^{16}O and ^{12}C nuclei by the induced activity method. A large contribution of a mechanism different from spallation has been deduced for the photoproduction of ^7Be from ^{12}C. (auth)

27557 ANALYSIS OF ELASTIC AND INELASTIC SCATTERING OF 185 MeV PROTONS WITH PARAMETRIZED REFLECTION COEFFICIENTS. Ingemarsson, A. (Uppsala Univ.). Phys. Scr.; 10: No. 4, 149-158(Oct 1974).

The differential cross section and the polarization of 185-MeV protons in the elastic scattering from ^{12}C, ^{40}Ca, ^{90}Zr and ^{208}Pb and in the inelastic scattering from the lowest octupole levels of the same nuclei were calculated. The calculations are based on a parametrization of the elastic scattering reflection coefficients and the Austern-Blair theory for one-phonon excitations in the adiabatic approximation. (auth)

27558 OPTICAL MODEL ANALYSIS OF PROTON AND DEUTERON SCATTERING AND DWBA CALCULATIONS ON (p,d)-REACTIONS AT 185 MeV. Ingemarsson, A.; Tibell, G. (Uppsala Univ.). Phys. Scr.; 10: No. 4, 159-170(Oct 1974).

Distorted-wave Born approximation (DWBA) calculations were performed for (p,d)-reactions in ^{12}C and ^{28}Si induced by 185 MeV protons, and the results were compared with experimental data on differential cross sections and vector polarizations. In order to obtain a consistent set of parameters for the potentials generating the distorted waves, a reanalysis was made of experimental data from proton and deuteron elastic scattering. The effect on the results of the spin-orbit terms in the optical potentials was studied, and it seems clear that at these intermediate energies the spin-orbit potentials are quite important e.g., in the extraction of spectroscopic factors. (auth)

27559 REACTION $^{12}C(\alpha,{}^{12}C^*)\alpha$. Rutkevich, N. Ya.; Klyucharev, A. P.; Zachepilo, G. A.; Kuz'michev, M. A.; Linetskii, A. R. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1737-1740 (Aug 1974). (In Russian).

As a result of a complete kinematic analysis of the reaction $^{12}C + \alpha \rightarrow 4\alpha$, channels were isolated in which excited states of the C nucleus appear as intermediate structure. A triangular Dalitz-Fabri diagram was constructed for the three particles corresponding to the decay of the excited C. (tr-auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 27094, 27520, 27544, 27550, 27552, 27556, 27558, 27576, 27577, 27601, and 27654.

27560 DOUBLE INTERNAL BREMSSTRAHLUNG IN ELECTRON CAPTURE. Ljubicic, A. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)); Jones, R. T.; Logan, B. A. (Ottawa Univ., Ontario (Canada). Dept. of Physics). Nucl. Phys., A; 236: No. 1, 158-164(23 Dec 1974).

Double internal bremsstrahlung has been observed in the electron capture decay of ^{37}Ar. The energy distribution of the two photons has been investigated, using a dual parameter pulse-height analysis system, at an angle of $\theta = 90°$ between two photon propagation vectors. For sum photon energies in the interval of 210-810 keV and at $\theta = 90°$ the ratio of the transition probabilities of double to single bremsstrahlung emissions was found to be $(4.8 \pm 0.4) \times 10^{-5}$. (auth)

27561 LIFETIME MEASUREMENTS IN ^{22}Mg. Grawe, H.; Holzer, K.; Kaendler, K. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik); Pilt, A. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Phys., A; 237: No. 1, 18-28(6 Jan 1975).

The $(^3He,n)$ reaction on implanted ^{20}Ne targets was used to measure lifetimes in ^{22}Mg with the Doppler-shift-attenuation method (DSAM). From n-γ coincidence spectra at 0°, 90° and 120° taken at 10 MeV bombarding energy, the following lifetimes and limits were deduced for the states at 1.25, 3.31, 4.40, 5.30 and 5.71 MeV: respectively, 4200 ± 1500 fs, 290 ± 65 fs, <30 fs, 63 ± 20 fs and 40 ± 15 fs. The results are discussed in comparison to the mirror nucleus ^{22}Ne and recent shell model and SU(3) predictions. (auth)

27562 THE $^{24}Mg(\alpha,\alpha')^{24}Mg$ REACTION; STATISTICAL ANALYSIS. Sauter, A. H.; Singh, P. P. (Indiana Univ., Bloomington (USA)). Nucl. Phys., A; 236: No. 2, 379-396(30 Dec 1974).

The $^{24}Mg(\alpha,\alpha')^{24}Mg$ reaction to the 1.37-MeV state has been studied over an α energy range of 9.625–13.825 MeV in ~40 keV steps, and over a 25°–160° angular interval. These cross sections have been analyzed in terms of statistical theory, and a number of deviations from its predictions are found. These deviations point to the importance of non-statistical processes, such as intermediate structure, to the α scattering. The average compound nuclear width of 62 ± 7 keV is found for ^{28}Si over the 18–22 MeV excitation. (auth)

27563 SPECTROSCOPIC STRENGTHS FOR ^{6}Li-INDUCED ALPHA-PARTICLE TRANSFERS ON ^{24}Mg. Draayer, J. P.; Gove, H. E.; Trentelman, J. P.; Anantaraman, N.; DeVries, R. M. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). Phys. Lett., B; 53: No. 3, 250-252(9 Dec 1974).

$^{24}Mg(^{6}Li,d)$ angular distributions for transitions to low-lying states in ^{28}Si are well fitted by exact finite-range DWBA calculations and yield relative spectroscopic strengths in good agreement with theoretical predictions as well as with the corresponding results from other α-particle transfer reactions. (auth)

27564 ELECTROFISSION OF ^{24}Mg. Chung, A. H.; Diamond, W. T.; Litherland, A. E.; Pai, H. L. (Toronto Univ., Ontario (Canada). Dept. of Physics); Goldemberg, J. (Sao Paulo Univ. (Brazil). Instituto de Fisica). Phys. Lett., B; 53: No. 3, 244-246(9 Dec 1974).

The electron-induced fission of ^{24}Mg leading to the ground states of two carbon nuclei has been studied using 25- to 45-MeV electrons. The observed $\sin^2 2\theta$ angular distribution of the carbon nuclei indicates the dominance of E2 virtual photon absorption. The yield of ground state carbon nuclei is observed to decrease with increasing excitation energy in ^{24}Mg above 24 MeV. (auth)

27565 ALPHA-PARTICLE SPECTROSCOPIC AMPLITUDES FOR SD SHELL NUCLEI. Draayer, J. P. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). Nucl. Phys., A; 237: No. 1, 157-181(6 Jan 1975).

Theoretical predictions for spectroscopic amplitudes corresponding to α-particle stripping and pickup reactions on all stable sd-shell nuclei with $16 \leq A \leq 28$ are tabulated. A pure $(0s)^4$ configuration for the internal wave function of the transferred nucleons is assumed. Initial and final states of the target and residual nuclei are taken to be members of pure rotational bands obtained by angular momentum projection from a single irreducible representation of SU(3). Using the tabulated results, the effect of representation mixing can be assessed. The predicted results for $^{18}O + \alpha \rightleftharpoons {}^{22}Ne$ and $^{20}Ne + \alpha \rightleftharpoons {}^{24}Mg$ are compared to results obtained with wave functions for ^{18}O and ^{20}Ne generated in shell model calculations. The results show that structural detail can be important, but that it rarely changes the simple prediction by more than a factor of two, with transfers predicted to be strong/weak remaining so when representation mixing is taken into account. (auth)

27566 HIGH SPIN STATES IN ^{21}Ne. Kuhlmann, E.; Hoffmann, A.; Albrecht, W. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Z. Phys.; 271: No. 1, 49-57(Nov 1974).

12 figs.; 3 tabs.; 17 refs.

States in ^{21}Ne up to 6.3 MeV have been investigated by means of the $^{18}O(\alpha,n\gamma)^{21}Ne$ reaction. The γ decay of individual levels was studied in coincidence with neutrons by using a neutron time-of-flight spectrometer. Revised branching ratios are given for the states at 5.34, 5.63, 5.82, and 6.03 MeV. Neutron–gamma angular distribution measurements yielded the following J^{π} assignments: 5.34: $7/2^-$, $5/2^+$; 5.63: $(3/2, 7/2)$; 5.78: $(3/2, 5/2)$; 6.03: $9/2^-$; 6.18: $(5/2, 7/2)$; and 6.27: $(7/2, 9/2)$. The results are discussed in the framework of the Nilsson model. (auth)

27567 STUDY OF INELASTIC DEUTERON SCATTERING FROM THE EVEN–EVEN ISOTOPES OF MAGNESIUM AND SILICON. Thomas, K. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Naturwissenschaftliche Fakultaet). 12 Jul 1972. 55p. (In German). INIS.

23 figs.; 11 tabs.; 38 refs.; with app. Available from the library of the Erlangen-Nuernberg Univ.

Differential cross-sections of the elastic and inelastic deuteron scattering from the nuclei $^{24,26}Mg$ and $^{28,30}Si$ were absolutely determined at an incident energy of 10 MeV on the Erlangen tandem accelerator. The measurements were carried out with $\Delta E-E$ semiconductor telescopes in connection with a PDP-7 computer system in on-line operation. For the numerical analysis of the data the DWBA code DWUCK was modified for the CDC 3,300 of the computer center of the Erlangen University. (GE)

27568 INTERNAL BREMSSTRAHLUNG IN THE ALLOWED DECAY OF ^{35}S. Berenyi, D.; Meszaros, S.; Varga, D.; Ujhelyi, Cs. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Debrecen). Nucl. Phys., A; 237: No. 2, 215-220(13 Jan 1975).

The internal bremsstrahlung spectrum from the allowed decay of ^{35}S was measured by means of a Ge(Li) detector. To eliminate the effect of external bremsstrahlung, a specially constructed transport magnet was applied to get rid of the beta-electrons which produce external bremsstrahlung. Thus, a better agreement with the KUB–Nilsson–Gebhardt theory was attained. (auth)

27569 VARIATION OF THE α-PARTICLE PICK-UP SPECTROSCOPIC FACTOR FROM ^{12}C TO ^{40}Ca. Audi, G.; Detraz, C.; Langevin, M.; Pougheon, F. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 237: No. 2, 300-308(13 Jan 1975).

$(^{3}He,^{7}Be)$ cross sections have been measured on A = 4n target nuclei between ^{12}C and ^{40}Ca. An α-particle pick-up spectroscopic factor is extracted from the data through a finite-range DWBA analysis. It is concluded that the overall changes of S_α between ^{12}C and ^{40}Ca are moderate, but that local variations exist; S_α is lower in the middle of the sd shell and higher for ^{40}Ca. (auth)

27570 THE PARTICLE–HOLE STATES IN SOME LIGHT NUCLEI CALCULATED WITH THE TWO-BODY DENSITY MATRIX OF THE GROUND STATES. Mihailovic, M. V.; Rosina, M. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Nucl. Phys., A; 237: No. 2, 229-234(13 Jan 1975).

Low-lying excited states are calculated within the particle–hole space using the previously introduced hermitian operator method. Calculations are performed on ^{16}O using the model space spanned by the $1p_{\frac{1}{2}}$, $1d_{\frac{5}{2}}$, $2s_{\frac{1}{2}}$ subshells and on the nuclei ^{20}Ne, ^{24}Mg, and ^{28}Si using the model space spanned by the 1d, 2s shell. The lowest state for each set of quantum numbers J, P, T is compared with the result of complete diagonalization and agrees in most cases within 1 or 2 MeV. In order to test the variational approach to density matrices in the previous paper, also the approximate two-body density matrix elements are used as input, and they give a similar agreement in most cases. (auth)

27571 USE OF PLANE Ge(Li) DETECTORS FOR MEASUREMENT OF THE RESONANCE ABSORPTION OF γ QUANTA. Kopanets, E. G.; Koval, A. A.; Kostin, V. Ya.; L'vov, A. N.; Migalenya, V. Ya.; Tsytko, S. P. pp 288-291 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (Ed.). Moscow; Atomizdat (1974). (In Russian).

Data obtained on the radiation width of the resonance levels of ^{27}Al with E_{exc} = 10.163 MeV indicated that plane Ge(Li) detectors with thin working layers can be used for the measurement of the resonance absorption of γ quanta from the reaction of the radiative capture of protons with supplementary collimating devices and special shielding from the background radiation. (JSR)

27572 DETECTION OF He IONS IN THE INTERACTION OF 70–MeV π^- WITH ALUMINUM. Doron, A.; Julien, J.; Moinester, M.A.; Palmer, A.; Yavin, A.I. (Centre d'Études Nucléaires de Saclay, Service de Physique Nucléaire à Haute Energie, 91190 Gif–sur–Yvette, France). Phys. Rev. Lett. 34: No. 8, 485-487 (24 Feb 1975).

We detected and identified He ions, predominantly α particles, in the reaction $\pi^- + {}^{27}Al \rightarrow He + X$ at $E_\pi = 70$ MeV. The differential cross section at 90° is 6±2 mb/sr in the energy range $E_{He} = 5.5-30$ MeV. The He yield decreases from 7 to 25 MeV, where it approaches zero. (auth)

27573 LIFETIME MEASUREMENTS IN ^{25}Mg. Roepke, H.; Brendler, W.; Betz, P.; Glattes, V.; Hammel, G. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Z. Phys.; 271: No. 1, 59-64(Nov 1974).

The mean lives of ^{25}Mg levels have been studied using the Doppler-shift attenuation method in the $^{24}Mg(d,p\gamma)$ reaction at E_d = 6 MeV. Except for the E_x = 6,873 keV level, all levels between 2 MeV excitation energy and the neutron binding energy could be investigated; 11 mean lives and 30 limits thereof were found. A large number of multipole transition rates could be deduced, and several parity assignments, made. The relevance of the data with respect to the rotational model is discussed. A serious breakdown of the K selection rule, which has been proposed earlier for some high-spin states, is confirmed. (auth)

27574 FLUCTUATION ANALYSIS OF THE $^{29}Si(d,\alpha)^{27}Al$ REACTION. Asfour, F.; Bakr, M. H. S.; El-Kamhawy, A.; El-Tahawy, M. S.; Farouk, M. A.; Gwaily, S. E. (Atomic Energy Authority, Cairo (Egypt)). Atomkernenergie; 24: No. 3, 196-198(1974).

The excitation functions of the α groups from the $^{29}Si(d,\alpha)^{27}Al$ reaction leading to the ground and the first two excited states of ^{27}Al were investigated in the deuteron energy range 2.0 to 2.5 MeV.

The measurements have been carried out at four scattering angles, 100°, 120°, 140° and 160°, in steps of 10 keV. Angle auto- and cross-correlations were calculated in terms of Ericson's theory of statistical fluctuations. The mean coherence width Γ of the ^{31}P compound nucleus was found to be (26 ± 8) keV at ≈18 MeV excitation energy, and the radius of interaction was found to be R = 4.8 fm. (auth)

27575 TWO PARAMETRIC GENERATOR COORDINATE WAVE FUNCTIONS FOR LIGHT NUCLEI. Mankoc-Borstnik, N.; Mihailovic, M. V. (Univ. of Ljubljana, Yugoslavia). Fizika, Suppl. (Zagreb); 6: 3-6(1974).

From Proceedings of Yugoslav nuclear physicists meeting, Zlatibor, Yugoslavia (29 May 1973).

The results of investigations of the basis spanned by a proposed trial function for neon-20 levels are presented. In this preliminary calculation the importance of generator coordinate parameters η and ϵ is explored. The calculations show that both these parameters together cause an appreciable lowering of the ground state energy compared to the energy obtained by varying the Nilsson deformation parameter only. (JFP)

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Refer also to abstracts 27520, 27557, 27569, 27594, 27598–27602, 27607, 27612, 27620, 27632, 27650, 27686, 27718, 27753, and 27760.

27576 (CONF-7209124-, pp 462-576) STATUS OF NEUTRON NUCLEAR DATA FOR IMPORTANT FAST REACTOR STRUCTURAL AND COOLANT MATERIALS. Schatz, B. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

Introductory information is given on the necessity for neutron nuclear data; then the status for various materials is discussed in detail. The most important materials for fast reactors from the point of view of absorption are Ni, Fe, and Cr; they are components of most cladding and structural materials. Cross sections for capture and scattering processes are the most significant. The most important coolant material is Na; and attention is, for the most part, restricted to this substance. (4 tables, 122 references) (RWR)

27577 (CONF-730923-, pp 307-311) CORRELATIONS BETWEEN DIFFERENT TYPES OF NUCLEAR REACTIONS. Fodor, I. (Central Research Inst. for Physics, Budapest). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

In the study of isobaric analog states certain correlations are found which can sometimes yield information about nuclear structure. Correlations between the different exit channels when isobaric analog states are excited by proton bombardment are mentioned first. Then the investigation of the γ decay of the different types of IAR's in the $1f_{\frac{7}{2}}-2p_{\frac{3}{2}}$ shell is discussed in greater detail. Results on the nuclei in the 2s–1d shell yielded correlations between the γ decay of the IAS and single-particle-transfer reactions. In the cases of the $p_{\frac{3}{2}}$, $p_{\frac{1}{2}}$, and $f_{\frac{7}{2}}$ resonances studied in the f–p shell, the parent, analog, and antianalog states were strongly fragmented. The main decay mode, however, was still the M1 transition. It is concluded that, as the isobaric analog states preserve their individuality with the help of their isospin ($T_>$) values, the bound single-particle proton states ($T_<$) can, in certain cases, avoid mixing with the neighboring excited states with the help of their parity quantum number. It happens when the antianalog state has opposite parity to the other excitations in this energy region. (1 figure, 1 table) (RWR)

27578 (KFK-2087) DEFORMATION OF ^{56}Fe FROM 104-MeV α-PARTICLE SCATTERING. Gils, H. J.; Rebel, H.; Nowicki, G.; Ciocanel, A.; Hartmann, D.; Klewe-Nebenius, H.; Wisshak, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Dec 1974. 40p. Dep. NTIS (US Sales Only) $5.00.

Differential cross sections were measured for the elastic and inelastic scattering of 104-MeV α-particles from ^{56}Fe. The angular distributions are analyzed in terms of coupled channels on the basis of a symmetric and asymmetric rotator model. The analyses use a semimicroscopic folding procedure and additionally in some cases the conventional extended optical model. Deformation parameters, rms-radii, multipole moments of nuclear matter, and transition probabilities were extracted. (auth)

27579 (N–74-27336) TITANIUM SPALLATION CROSS SECTIONS BETWEEN 30 AND 584 MeV AND ^{39}Ar ACTIVITIES ON THE MOON. Steinburnn, F.; Fireman, E. L. (Smithsonian Astrophysical Observatory, Cambridge, Mass. (USA)). Apr 1974. 11p. (NASA-CR–134251; SAO–404-068). NTIS $4.00.

The production cross sections of ^{39}Ar for Ti spallation at 45-, 319-, 433-, and 584-MeV proton energies were measured to be 0.37 ± 0.09, 12.4 ± 3.7, 9.1 ± 2.7, and 17.8 ± 6.2 mb, respectively. Normalized ^{39}Ar production rates and activities are also derived for protons above 40 MeV and for three differential proton spectra of the type approximately E(- alpha). It is concluded that, even for samples of high Ti content, Ti spallation by solar protons below 200 MeV energy does not contribute significantly to their ^{39}Ar radioactivity. (auth)

27580 MEAN LIFETIMES OF LEVELS IN ^{48}V. Haas, B.; Taras, P.; Merdinger, J. C.; Vaillancourt, R. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire). Nucl. Phys., A; 236: No. 2, 405-415(30 Dec 1974).

Lifetimes for a number of levels in ^{48}V have been measured using the recoil-distance technique and the Doppler-shift attenuation method. The levels were populated via the ^{34}S(^{16}O,pn)^{48}V reaction at 34 MeV incident beam energy. Results have been obtained for the following levels (τ in ps): 428 keV, 5^+, 12.0 ± 3.6; 627 keV, 6^+, 105 ± 10; 745 keV, 2^-, 24.9 ± 2.6; 1056 keV, 3^-, 6.3 ± 2.5; 1099 keV, 5^+, 6.0 ± 1.4; 1255 keV, $7^{(+)}$, <5; 1588 keV, 4^-, <10; 1650 keV, $8^{(+)}$, <1.7; 1686 keV, 6, <5; 2063 keV, 5^-, <3; 2627 keV, $9^{(+)}$, <1.7. The feeding time for this reaction was found to be <1.7 ps. The results contradict a recent interpretation of the 1099-keV state as being a band head of a negative-parity band, while they confirm the negative parity up to 5^- for the band based on the 1^- 519-keV state. (auth)

27581 SHELL-MODEL STUDY OF ^{44}Ti USING A PAIRING-PLUS-SURFACE-TENSOR INTERACTION. Banerjee, D. (University Coll. of Science, Calcutta (India)). Nucl. Phys., A; 236: No. 1, 67-76(23 Dec 1974).

The nucleus ^{44}Ti is studied in the framework of the conventional shell model using a pairing-plus-surface-tensor interaction (PSTI). The nucleus ^{40}Ca is assumed to be an inert core. Only $1f_{\frac{7}{2}}$ and $2p_{\frac{3}{2}}$ single-particle orbits are included in the model vector space. Low-lying energy levels are calculated and compared with the experimental spectrum. The agreement is good. B(E2) values for transitions between levels of the ground-state band are also presented. The theory–experiment comparison suggests that the PSTI provides a reasonably good description of ^{44}Ti. (auth)

27582 THE ^{46}Ti(p,γ)^{47}V, ^{50}Cr(p,γ)^{51}Mn, ^{58}Ni(α,γ)^{62}Zn AND ^{58}Ni(α,p)^{61}Cu CROSS SECTIONS. Rios, M.; Anderson, B. D.; Schweitzer, J. S. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., A; 236: No. 2, 523-532(30 Dec 1974).

The ^{46}Ti(p,γ)^{47}V, ^{50}Cr(p,γ)^{51}Mn, ^{58}Ni(α,γ)^{62}Zn and ^{58}Ni(α,p)^{61}Cu cross sections have been measured in the energy range of interest for stellar nucleosynthesis during oxygen and silicon burning. The results are compared with statistical theory calculations which attempt to treat excited state effects and the γ-ray channel more realistically than previous calculations. (auth)

27583 DIFFERENTIAL ELASTIC SCATTERING CROSS SECTIONS OF Fe AND Ni FROM 10 TO 700 keV. Zuhr, R. A.; Min, K. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Dept. of Physics). Nucl. Phys., A; 237: No. 1, 29-44(6 Jan 1975).

Differential elastic scattering cross sections of neutrons from natural Fe and Ni were measured in the energy region between 10 and 700 keV. The measurements were made at six angles ranging from 30° to 150°, and the differential cross sections were determined relative to the known cross sections of natural Pb. The principal angular distribution results are presented in terms of the Legendre polynomial expansion coefficients as functions of energy. Two sets of coefficients corresponding to averaged values over 20 and 50 keV are given. Comparisons are made with the available data on total and differential elastic scattering cross sections. The data are consistent with the interpretation that s-wave scattering is dominant throughout the region of measurement, while p-wave scattering becomes evident above 200 keV. There seems to be appreciable d-wave contribution above 400 keV. The gross features of angular distribution coefficients are characterized by resonant structure with widths of the order of 100 keV. (auth)

27584 AVERAGE CROSS-SECTIONS FOR (n,α) AND (n,p) REACTIONS ON TITANIUM IN A FISSION-TYPE REACTOR SPECTRUM. Bruggeman, A.; Maenhaut, W.; Francois, J. P.; Hoste, J. (Rijksuniversiteit, Ghent). J. Radioanal. Chem.; 23: No. 1-2, 131-146(1974).

The average cross section in a fission-type reactor spectrum was determined experimentally for the reactions $^{46}Ti(n,p)^{46}Sc$, $^{47}Ti(n,p)^{47}Sc$, $^{48}Ti(n,p)^{48}Sc$, $^{48}Ti(n,\alpha)^{45}Ca$, and $^{50}Ti(n,\alpha)^{47}Ca$. In order to obtain the (n,p) cross sections, reactor irradiation of titanium was followed by measurement of the induced scandium activities with a Ge(Li) detector of calibrated detection efficiency. For this no chemical separations had to be carried out. For the (n,α) reactions, however, the induced calcium activities were separated and purified by oxalate precipitation, after the bulk of the radioactivity had been removed by precipitation of titanium hydroxide. The ^{47}Ca disintegration rate was determined in the same way as for the scandium isotopes, whereas for ^{45}Ca liquid scintillation counting was carried out. The shape of the reactor spectrum was investigated by irradiating reference threshold detectors with different effective threshold energies. To correct for (n,γ) interferences, irradiations were carried out with and without cadmium shielding. On the basis of $\bar{\sigma}_F$ = 0.64 mb for the reaction $^{27}Al(n,\alpha)^{24}Na$, the average cross sections were as follows: $^{46}Ti(n,p)^{46}Sc$: 10.5 ± 0.4 mb; $^{47}Ti(n,p)^{47}Sc$: 16.3 ± 0.6 mb; $^{48}Ti(n,p)^{48}Sc$: 0.272 ± 0.005 mb; $^{48}Ti(n,\alpha)^{45}Ca$: 34μb; $^{50}Ti(n,\alpha)^{47}Ca$: 8.1 ± 0.3 μb. (2 figures, 6 tables) (auth)

27585 INVESTIGATION OF NEUTRON-DEFICIENT NUCLEI OF THE $1f_{\frac{7}{2}}$-SHELL BY MEANS OF HEAVY ION REACTIONS. Huber, R. B. (Technische Univ. Muenchen (F. R. Germany). Fakultaet fuer Allgemeine Wissenschaften). 7 Jul 1972. 81p. (In German). INIS.

36 figs.; 10 tabs.; 74 refs. Available from the library of the TU Muenchen.

This work reports on gamma spectroscopic studies of neutron-deficient nuclei of the $1f_{\frac{7}{2}}$ shell. These nuclei, whose properties have remained largely unknown so far, have been populated for the experiments by means of heavy-ion reactions. ^{10}B, ^{12}C, ^{14}N, ^{16}O, ^{32}S, and ^{40}Ca have been used as projectiles; the targets were ^{40}Ca, ^{32}S, and ^{10}B. Level schemes could be established or supplemented for ^{50}Cr, ^{48}Cr, ^{48}V, ^{47}V, ^{47}Ti, and ^{44}Ti by measuring the excitation functions, particle–gamma, and gamma–gamma coincidences. Spin assignment has been made amongst others by angular distribution measurements. The lifetimes of several levels have been determined on the basis of measurements according to the recoil-distance Doppler-shift method. The resulting transition strengths together with the known values for the remaining nuclei provide information about the collective effects in the $1f_{\frac{7}{2}}$ shell. (GE)

27586 AVERAGE CROSS-SECTIONS FOR (n,p) REACTIONS ON CALCIUM IN A FISSION-TYPE REACTOR SPECTRUM. Bruggeman, A.; Maenhaut, W.; Hoste, J. (Rijksuniversiteit, Ghent). J. Radioanal. Chem.; 23: No. 1-2, 101-112(1974).

The average cross section in a fission-type reactor spectrum $\bar{\sigma}_F$ was experimentally determined for the reactions $^{42}Ca(n,p)^{42}K$, $^{43}Ca(n,p)^{43}K$, and $^{44}Ca(n,p)^{44}K$. Calcium carbonate samples and fast-neutron flux monitors were irradiated with and without cadmium shielding in the Thetis reactor (Institute for Nuclear Sciences, Rijksuniversiteit Ghent). The potassium activities induced in the calcium carbonate samples were separated and purified by tetraphenylborate precipitation, after which they were measured with a Ge(Li) detector of calibrated detection efficiency. On the basis of $\bar{\sigma}_F$ = 0.64 mb for the reaction $^{27}Al(n,\alpha)^{24}Na$, the average cross sections were as follows: $^{42}Ca(n,p)^{42}K$: 2.82 ± 0.07 mb; $^{43}Ca(n,p)^{43}K$: 1.89 ± 0.05 mb; $^{44}Ca(n,p)^{44}K$: 0.065 ± 0.003 mb. (2 figures, 3 tables) (auth)

27587 SPIN ASSIGNMENTS FOLLOWING HEAVY-ION INDUCED REACTIONS. Taras, P.; Haas, B. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire). Nucl. Instrum. Methods; 123: No. 1, 73-82(1 Jan 1975).

An essentially model-independent method is presented which allows the extraction of spin and mixing ratio values from the measurements of γ-ray excitation functions and angular distributions following heavy-ion induced reactions. The critical assumption is that the initial state observed be fairly well aligned, as has been found to be the case in all heavy-ion-induced reactions studied so far. The analysis proceeds from the initial state down the γ-ray cascade to the ground state and takes into account the contribution due to side feeding. The actual form of the magnetic substate distribution of the initial state is found to be not important, although a Gaussian distribution with width σ = 1.0–2.0 is used since it appears to have a reasonable physical basis. It is pointed out that the γ-ray angular distribution "typical" of stretched quadrupole transition cascades may also be fitted by dipole–quadrupole mixtures. In the past, this point has been largely ignored in assigning spins to over 300 states in the heavier mass region. (auth)

27588 REDETERMINATION OF THE SLOW NEUTRON SCATTERING CROSS SECTION FOR VANADIUM. Dilg, W. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Dept.). Nucl. Instrum. Methods; 122: No. 3, 343-346(15 Dec 1974).

Significant discrepancies exist in available data on the slow-neutron scattering cross section of vanadium, which has been used as a reference standard in many scattering experiments. An accurate measurement of the vanadium total cross section has been made at 18.8 eV neutron energy in transmission, with the result (4.98 ± 0.02) b. Correction for capture at this energy gives (4.79 ± 0.03) b for the free-atom scattering cross section, which is lower than the BNL 325 recommendation by 3%, or five times the error, but agrees with a recent measurement by Vertebni et al. The discrepancies in previous results are briefly discussed. (auth)

27589 MUONIC ISOTOPE SHIFTS IN THE EVEN Fe NUCLEI. Shera, E.B.; Ritter, E.T.; Rinker, G.A. Jr.; Bennett, M.J.; Perkins, R.B. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544); Wohlfahrt, H.D.; Fricke, G.; Wagner, L.K.; Kleinheinz, P.; Sheline, R.K.; Steffen, R.M.; Negele, J.W. Phys. Rev. Lett. 34: No. 9, 535-538 (3 Mar 1975).

Isotope shifts of the $2p \rightarrow 1s$ muonic transition energies in $^{54,56,58}Fe$ have been measured. The results indicate that the charge radii of these isotopes vary approximately as $A^{1/3}$. Whereas spherical Hartree–Fock calculations can account for less than one third of the observed isotope shifts, deformed Hartree–Fock results reproduce two thirds of the observed shifts. It is suggested that the remaining discrepancy is primarily due to neglected neutron–proton residual interactions. (auth)

27590 FAST NEUTRON INDUCED [(n,t) + (n,n't)] REACTION CROSS SECTIONS IN THE MEDIUM AND HEAVY MASS REGIONS. Qaim, S. M.; Woelfle, R.; Stoecklin, G. (Kernforschungsanlage, Juelich, Ger.). J. Inorg. Nucl. Chem.; 36: No. 12, 3639-3642 (Dec 1974).

Cross sections have been measured for the formation of tritium via (n,t) and (n,n't) reactions on Ti, Mn, Cu, Ga, Nb, ^{92}Mo, Ag, In, Sb, Ta, Re, Au and Bi with fast neutrons produced via break-up of 53 MeV deuterons on a Be-target (maximum intensity of the neutrons at $\bar{E}_n \approx 22.5$ MeV). The activation technique in combination with vacuum extraction and "low-level" gas phase β^--counting of tritium was employed. The cross sections lie between 3.5 and 5.5 mbarn and decrease only slightly with increasing Z of the target element. A comparison of the cross section systematics at E_n = 14.6 and 22.5 MeV suggests that at the latter energy possibly a greater contribution from direct interaction processes is involved. (auth)

27591 INTERACTION OF NEUTRONS WITH IRON NUCLEI IN 16 TO 22 MeV ENERGY RANGE. Korkal'chuk, V.; Prokopets, G. A.; Holmkvist, B. (Kiev State Univ.). Yadern. Fiz.; 20: No. 6, 1096-1105(Dec 1974). (In Russian).

The γ-ray spectra produced in the interaction of neutrons with iron nuclei were measured at the energies E_n = 16.2, 18.1, 19.3, 20.5, and 21.8 MeV. The absolute values of excitation cross sections of some γ lines are presented. The possibilities of such experiments to give spectroscopic information and information on the mechanism of neutron (in particular (n, 2n)) reactions are discussed. (auth)

27592 ENERGY SPECTRUM OF ^{51}V BY THE INTERMEDIATE COUPLING APPROACH. Chung, W. H. (Univ. of Manitoba, Winnipeg). Aust. J. Phys.; 27: No. 2, 289-292(Apr 1974).

Level energies of the low lying excited states in ^{51}V were calculated using the intermediate coupling approach of the unified model. (auth)

27593 NUCLEAR INTERACTION PARAMETERS IN CIRCUMBARRIER EXCITATION REACTIONS OF NICKEL BY LIGHT NUCLEI. Titov, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1733-1736 (Aug 1974). (In Russian).

The circumbarrier excitation of the one-phonon 2^+ level of ^{58}Ni in reactions with ^3He, ^6Li, and ^{16}O was studied. It was found that the nuclear interaction parameters for reactions with He and Li differ quite strongly from the interaction parameters of O. This leads to a smoothing out of the interference effect in reactions with ^3He and ^6Li. (2 figures, 1 table) (tr-auth)

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Refer also to abstracts 25345, 25834, 27094, 27520, 27552, 27576, 27577, 27583, 27590, 27613, 27616, 27620, 27625, 27632, 27654, and 27680.

27594 (BNL–50435) NEUTRON AND GAMMA-RAY PRODUCTION CROSS-SECTIONS FOR NICKEL. Bhat, M. R. Brookhaven National Lab., Upton, N. Y. (USA)). Oct 1974. Contract AT(30-1)-16. 76p. (ENDF–207). Dep. NTIS $5.45.

The evaluation of the neutron cross-section and gamma-ray production data on nickel from 1.0×10^{-5} eV to 20.0 MeV is described. Available data as of mid-1973 are included. In addition, an attempt was made to estimate the errors in the various cross sections in the different energy ranges. The resonance parameters are given only for the four even–even isotopes of nickel; the contribution of ^{61}Ni is considered negligible. (44 figures, 8 tables, 139 references) (RWR)

27595 (EURFNR-1233) TOTAL NEUTRON CROSS SECTIONS OF ^{63}Cu AND ^{65}Cu IN THE ENERGY REGION 34 TO 150 keV. Beer, H.; Spencer, R. R.; Rohr, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Oct 1974. 23p. (KFK-2056). Dep. NTIS (US Sales Only) $4.25.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Neutron total cross sections of ^{63}Cu and ^{65}Cu were determined in the energy region from 34 to 150 keV by means of transmission measurements on enriched samples. R-matrix fits to the transmission data were carried out, and the parameters which were derived are presented. (10 figures, 4 tables) (auth)

27596 STRUCTURE OF ^{88}Kr DERIVED FROM THE ^{86}Kr(t,p)^{88}Kr REACTION. Sherman, J.; Flynn, E. R.; Stein, N. (Los Alamos Scientific Lab., N. Mex. (USA)); Olsen, D.; Riley, P. (Texas Univ., Austin (USA)). Phys. Lett., B; 53: No. 3, 241-243(9 Dec 1974).

The ^{86}Kr(t,p)^{88}Kr reaction has been used to measure the previously unknown ^{88}Kr level spectrum. Comparison of the proton angular distributions to DWBA predictions leads to J^{π} assignments for many observed levels. (auth)

27597 THE G-FACTOR MEASUREMENT FOR THE 8^+ ISOMERIC STATE OF ^{86}Sr PRODUCED IN Kr GAS. Matthias, E.; Recknagel, E.; Hashimoto, O.; Nagamiya, S.; Nakai, K.; Yamazaki, T.; Yamazaki, Y. (Tokyo Univ. (Japan). Dept. of Physics). Nucl. Phys., A; 237: No. 1, 182-188(6 Jan 1975).

The g-factor of the 8^+ isomeric state ($T_{1/2}$ = 460 nsec) in ^{86}Sr, produced via the Kr(α,2n)Sr reaction, was determined to be $g(8^+,{}^{86}Sr) = -0.243 \pm 0.004$ by the stroboscopic resonance method. It was found that about half of the nuclear alignment was preserved in the gaseous environment. (auth)

27598 (d,t) REACTIONS ON ^{54}Cr, ^{67,69}Zn NUCLEI. Borsaru, M.; Nurzynski, J.; Gebbie, D. W.; Hollas, C. L.; Whineray, S.; Merrill, N. H.; Barbopoulos, L. O.; Quinton, A. R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Nucl. Phys., A; 237: No. 1, 93-110(6 Jan 1975).

Levels in ^{53}Cr, ^{66,67}Zn have been investigated using the (d,t) reaction at 12 MeV deuteron energy. Angular distributions have been measured, and spectroscopic factors, obtained from a comparison with the DWBA predictions. A clear j-dependence which could be fitted with DWBA was observed for low-lying $l_n = 1$ transitions in ^{67}Zn. A j-dependence for both $l_n = 1,3$ transitions in ^{53}Cr was also seen, neither of which could be reproduced by DWBA. Filling coefficients and centre-of-gravity energies were obtained for ^{68}Zn, and both were compared to the predictions of the simple pairing theory. (auth)

27599 AN EXPERIMENTAL STUDY OF NEUTRON RADIATIVE CAPTURE IN ^{60}Ni AND Fe IN THE THERMAL TO LOW KEV RANGE. Brown, P. H.; Block, R. C.; Tatarczuk, J. R. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). Nucl. Phys., A; 236: No. 1, 45-60(23 Dec 1974).

The spectrum of γ-rays given off following radiative neutron capture in ^{60}Ni and Fe has been studied as a function of neutron energy. The RPI LINAC provided the pulsed neutron source, and the neutron energy was determined by the time-of-flight method using a lithium-drifted germanium [Ge(Li)] detector. The intensities of prominent γ-rays in the capture spectra were measured as a function of neutron energy from thermal to low-keV neutron energies, and the partial capture cross sections for these prominent γ-rays were measured in the low-eV to low-keV neutron energy range. (auth)

27600 ISOMERIC CROSS SECTIONS FOR THE (n,2n) REACTION ON ^{82}Se, ^{81}Br, AND ^{45}Sc AT 15.1 MEV. Kao, T. H.; Alford, W. L. (Auburn Univ., Ala. (USA)). Nucl. Phys., A; 237: No. 1, 11-17(6 Jan 1975).

Activation techniques have been used to measure the cross sections at 15.1 MeV neutron energy for the following reactions: ^{82}Se(n,2n)$^{81m+g}$Se, ^{81}Br(n,2n)$^{80m+g}$Br, and ^{45}Sc(n,2n)$^{44m+g}$Sc. Isomeric cross-section ratios were evaluated by applying the method of least squares to the time behavior of γ-ray activity following the ground-state decay of each isomeric pair. The absolute cross section σ_m for the formation of the metastable state was measured by the mixed powder method with the ^{27}Al(n,α)^{24}Na reaction as the monitor. The cross section σ_g for the formation of the ground state was then determined by using the isomeric cross-section ratio. The sum of σ_m and σ_g for each reaction is compared with the theoretical value obtained from calculations based on the statistical model for the formation of a compound nucleus and its subsequent emission of neutrons. (auth)

27601 INFINITE DILUTION RESONANCE INTEGRALS FOR SOME SHORT-LIVED RADIOISOTOPES. Van der Linden, R.; De Corte, F.; Hoste, J. (Rijksuniversiteit, Ghent). J. Radioanal. Chem.; 23: No. 1-2, 113-122(1974).

The infinite-dilution resonance integrals of fifteen (n,γ) reactions leading to the production of short-lived radioisotopes were determined. The irradiation parameters were checked by comparing the results of different methods, and the measuring equipment was carefully controlled. (3 figures, 5 tables) (auth)

27602 CONTINUOUS PROTON SPECTRA EMITTED IN ^{3}He AND DEUTERON INDUCED REACTIONS. Chevarier, A.; Chevarier, N.; Demeyer, A. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire); Alevra, A.; Lukas, I. R.; Magda, M. T.; Nistor, M. E. (Institutul de Fizica Atomica, Bucharest (Romania)). Nucl. Phys., A; 237: No. 2, 354-364(13 Jan 1975).

A study of the energy and angular distributions of protons emitted in ^{3}He-induced reactions was undertaken at an incident energy of 25.6 MeV. An analysis in the framework of the pre-equilibrium hybrid model did not succeed in explaining the overall behavior of proton spectra; a contribution due to a break-up or a double stripping of the incident particle has to be taken into account. An attempt was made to account for these processes by performing a phase space calculation. This formulation was first tried in the case of deuteron-induced reactions for which a break-up mechanism has already been confirmed in continuous proton spectra. The calculation extended to the case of ^{3}He-induced reactions showed that a double stripping mechanism could explain the observed distribution. (auth)

27603 DECOUPLED BAND IN ^{73}As. Protop, C.; Heits, B.; Friedericks, H. G.; Zell, K. O.; von Brentano, P. (Koeln Univ. (F. R. Germany). Inst. fuer Kernphysik). Z. Phys.; 271: No. 1, 65-68(Nov 1974).

Using the (α,2nγ) reaction, we have established a partial decay scheme of ^{73}As. A positive-parity band built on the 428-keV, $^{9}/_{2}^{+}$ level is interpreted as a decoupled band. (auth)

27604 GAMMA DECAY OF THE $p_{\frac{3}{2}}$ ANALOG STATE IN ^{61}Cu. Kraft, O. E.; Naumov, Yu. V.; Sizov, I. V. (Leningrad State Univ.). Yadern. Fiz.; 20: No. 6, 1081-1087(Dec 1974). (In Russian).

Gamma-ray spectra of resonances in ^{60}Ni(p,γ)^{61}Cu reaction were measured at proton energies E_p = 1588, 1599, 1605, and 1620 keV. These resonances were identified as fine structure components of the $p_{\frac{3}{2}}$ analogue state. The intensities of the population of the ^{61}Cu states with excitation energy up to 3 MeV were obtained. The decay scheme of these states was constructed. Comparison of the results with those from β decay indicates the necessity of taking into account an l part in the M1 gamma transition operator, when the role of the core polarization mode in gamma decay of IAR is investigated. The analog–antianalog transition is about ten times retarded as compared with the single-particle estimate. (3 figures, 1 table) (auth)

27605 ELASTIC MAGNETIC SCATTERING OF ELECTRONS ON THE NUCLEUS ^{59}Co. Likhachev, V. P.; Afanas'ev, N. G.; Nemashkalo, A. A.; Savitskii, G. A.; Khvastunov, V. M.; Yaroshevskii, L. D. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 20: No. 6, 1113-1116(Dec 1974). (In Russian).

Results of measurement of the differential cross section for electron elastic scattering on the nucleus ^{59}Co are presented. The experimental data obtained are discussed in framework of the Born approximation and the one-particle shell model. The magnitude of the M7 magnetic moment for the nucleus ^{59}Co is determined. (auth)

27606 COULOMB EXCITATION OF THE ^{73}Ge NUCLEUS. Andreev, D. S.; Erokhina, K. I.; Zvonov, V. S.; Lemberg, I. Kh.; Leonov, N. N. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1668-1672(Aug 1974). (In Russian).

The Coulomb excitation of ^{73}Ge was studied during the bombardment of 91.4% enriched targets with 6.8-MeV α particles and 30-MeV C ions. The γ quanta were detected with a Ge(Li) detector with a working volume of 29 cm^3. The Coulomb excitation of levels at 868.0 and 993.7 keV was studied for the first time. Direct and cascade transitions of these levels were observed. The reduced transition probabilities were measured for all levels up to 994

keV inclusive. An energy-level scheme was constructed. (1 figure, 1 table) (tr-auth)

27607 GAMMA DECAY OF ANALOG RESONANCES. Naumov, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1617-1626 (Aug 1974). (In Russian).

The large amount of experimental data on the γ decay of isobaric analog resonances represents a series of interesting physics problems and peculiarities. Some of these are connected with those circumstances surrounding the γ decay of states differing from other states by an isospin of 1 and having spherical, relatively simple wave functions. Other problems are caused by those factors which break up highly excited states, tending to continuous or quasi-continuous spectra. These characteristics are examined in this review. (7 figures) (JSR)

27608 SEMIDIRECT CAPTURE MODEL AND THE ANGULAR DISTRIBUTION OF γ-RAYS FROM THE RADIATIVE CAPTURE OF FAST NEUTRONS. Likar, A.; Potokar, M.; Cvelbar, F. (Univ. of Ljubljana, Yugoslavia). Fizika, Suppl. (Zagreb); 6: 9-10(1974).

From proceedings of Yugoslav nuclear physicists meeting; Zlatibor, Yugoslavia (29 May 1973).

Since there is a considerable difference between the two spectra in strontium-88 (n,γ) strontium-89, indicating rather strong anisotropy, the semidirect capture model is refined, and the angular distribution of capture gamma rays is calculated. (JFP)

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Refer also to abstracts 25345, 25828, 25886, 27150, 27520, 27557, 27590, 27601, 27602, 27638, 27639, 27726, 27728, 27735, 27749, and 27760.

27609 (KFK-2065) ELASTIC AND INELASTIC SCATTERING OF ALPHA PARTICLES AND FOLDING MODEL. Rebel, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Sep 1974. 49p. Dep. NTIS (US Sales Only) $5.50.

A microscopic approach generating the optical potential by folding an adequate bound-nucleon-projectile effective interaction into the nucleon density distribution was reviewed for elastic and inelastic scattering of α-particles. (auth)

27610 GYROMAGNETIC RATIOS OF EXCITED STATES IN ^{123,125}Te. Roney, W. M.; Gebbie, D. W.; Borchers, R. R. (Wisconsin Univ., Madison (USA)). Nucl. Phys., A; 236: No. 1, 165-172(23 Dec 1974).

The results of integral precession measurements are reported for $^3/_2^+$ and $^5/_2^+$ excited states in ^{123,125}Te. The measurements were made using the ion implantation perturbed angular correlation technique by recoiling the excited nuclei into polarized iron. The measured mean lifetimes and g-factors are ^{122}Te: (440 keV, $^3/_2^+$) $\tau = 39 \pm 4$ ps, $g = 0.34 \pm 0.06$; (505 keV, $^5/_2^+$) $\tau = 26 \pm 3$ ps, $g = 0.04 \pm 0.025$; and ^{125}Te: (443 keV, $^3/_2^+$) $\tau = 27 \pm 3.3$ ps, $g = 0.39 \pm 0.06$; (464 keV, $^5/_2^+$) $g = 0.12 \pm 0.04$. The results are compared with theoretical predictions. (auth)

27611 HIGH-SPIN STATES AND EVIDENCE FOR HOLE–CORE COUPLING IN THE $^{143}Sm_{81}$ AND $^{145}Gd_{81}$ NUCLEI. Kownacki, J.; Ludziejewski, J.; Sujkowski, Z. (Institute of Nuclear Research, Warsaw (Poland)); Arnold, H. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)); Ryde, H. (Research Institute for Physics, AFI, Stockholm 50, Sweden). Nucl. Phys., A; 236: No. 1, 125-157(23 Dec 1974).

The level structure of the ^{143}Sm and ^{145}Gd nuclei has been studied using the ^{142}Nd $(\alpha,3n\gamma)^{143}$Sm and ^{144}Sm$(\alpha,3n\gamma)^{145}$Gd reactions. Singles γ-ray, $\gamma-\gamma$ coincidence spectra, angular and time distributions with respect to the beam burst have been measured. Gamma transitions between excited states with spin values up to $^{23}/_2$ in ^{143}Sm and up to $^{21}/_2$ in ^{145}Gd have been observed. The observed level structure in both nuclei can be explained if the neutron-hole is coupled to the doubly even core excitations. The coupling of the $h_{11/2}$ neutron-hole with the 2^+ and 3^- vibrations is calculated in the weak and intermediate coupling models. The results obtained in these calculations are in reasonably good agreement with the experimental data. The energies of the three-particle states, being the result of the coupling of the $h_{11/2}$ neutron-hole with the two-proton excitations in the core, are nicely reproduced in the calculations. Empirical values of the two-body interaction matrix elements have been used. However, the three-particle calculation does not explain the existence of the 30-ms $(^{23}/_2^-)$ isomeric level in the ^{143}Sm nucleus. (auth)

27612 SELF-CONSISTENT CALCULATIONS FOR HIGHLY EXCITED COMPOUND NUCLEI. Mosel, U.; Zint, P. G.; Passler, K. H. (Giessen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 236: No. 1, 252-268(23 Dec 1974).

A method for self-consistently calculating average nuclear properties at high excitation energies is derived. Calculations using this formalism have been performed for a double-magic and a deformed nucleus employing the Skyrme force for the nucleon–nucleon interaction. The effects of excitation energy on the nuclear structure are discussed, and a comparison of self-consistently calculated level densities with those obtained in the usual statistical method is made. The calculations for the deformed nucleus show the transition from the deformed to a spherical shape with increasing excitation. (auth)

27613 SHELL MODEL FOR N = 49 NUCLEI. Gross, R.; Frenkel, A. (Weizmann Inst. of Science, Rehovoth (Israel)). Phys. Lett., B; 53: No. 3, 227-230(9 Dec 1974).

The behavior of N = 49 nuclei is examined in terms of a model based on a ^{88}Sr core with a $1g_{9/2}$ neutron-hole. Effective interactions between $1g_{9/2}$ neutrons and $1g_{9/2}-2p_{1/2}$ protons are determined from the spectra of ^{88}Y, ^{89}Zr, ^{90}Mo. Close agreement is obtained also with experimental level spacings of ^{92}Tc and ^{93}Ru, as well as binding energies. (auth)

27614 ELASTIC SCATTERING OF ^{3}He AND ^{4}He AT INCIDENT ENERGIES NEAR THE COULOMB BARRIER. Eisen, Y.; Abramson, E.; Engler, G.; Samuel, M.; Smilansky, U.; Vager, Z. (Weizmann Inst. of Science, Rehovoth (Israel)). Nucl. Phys., A; 236: No. 2, 327-339(30 Dec 1974).

The elastic scattering of ^{3}He and ^{4}He from Zr, Mo, Cd, and Te isotopes is studied at incident energies near the Coulomb barrier. Marked differences are observed between the excitation curves of ^{3}He and ^{4}He. These differences are shown to be due to a large surface absorption in the ^{3}He scattering. A systematic study of the size parameters deduced from the present and other ^{4}He experiments shows deviations from the $A^{\frac{1}{3}}$ law for nuclei near closed neutron shells. (auth)

27615 COHERENCE EFFECTS IN THE (p,α) REACTION. Smits, J. W.; Iachello, F.; Siemssen, R. H.; van der Woude, A. (Rijksuniversiteit Groningen (Netherlands). Kernphysisch Versneller Instituut). Phys. Lett., B; 53: No. 4, 337-340(23 Dec 1974).

Coherence effects between the picked-up proton and di-neutron configurations are shown to dominate the (p,α) reaction in agreement with a model proposed by Bayman. An approach based on the separation of the di-neutron and proton excitations yields a quantitative description of the relative population of states in the ^{118}Sn(p,α)^{115}In reaction. (auth)

27616 INELASTIC ELECTRON SCATTERING CALCULATIONS ON N = 50 ISOTONES. Hofstra, P.; Roos, J.; Boeker, E. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.). Nucl. Phys., A; 236: No. 1, 10-12(23 Dec 1974).

The first excited 2^+, 3^- and 4^+ levels in ^{88}Sr, ^{90}Zr and ^{92}Mo are described by the seniority v = 2 shell model and by the two-quasiparticle BCS model. In both models the DWBA cross sections for inelastic electron scattering are calculated. It appears that both models often give the same cross sections, the overall normalization being then the difference. The agreement with the experimental data for ^{90}Zr and ^{92}Mo for the shell model case is much better than for the BCS model. (auth)

27617 FAST NEUTRON SCATTERING FROM CESIUM. Barnard, E.; Coetzee, N.; De Villiers, J. A. M.; Reitmann, D.; Van der Merwe, P. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Z. Phys.; 271: No. 1, 1-6(Nov 1974).

5 figs.; 13 refs.

A study was made of the (n,n), (n,n') and (n,n'γ) reactions which occur when a cesium scattering sample is exposed to monoenergetic neutrons of energies ranging from 120 to 1910 keV. Total cross sections, elastic scattering, angular distributions and excitation functions for inelastic scattering were measured with a neutron time-of-flight spectrometer. Results are compared with statistical theory. A 40-cm^3 Ge(Li) detector was used in the time-gated mode to measure γ-rays from the (n,n'γ) reaction. These data were used to refine and extend the energy level scheme derived from the neutron spectroscopy measurements and mainly confirm the results of recent, similar measurements. (auth)

27618 INTERPLAY OF VALENCE-SHELL CLUSTERS AND THE VIBRATIONAL FIELD IN ^{94}Mo AND ^{95}Mo. Paar, V. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). Z. Phys.; 271: No. 1, 11-16(Nov 1974).

1 fig.; 1 tab.; 29 refs.

The properties of ^{94}Mo and ^{95}Mo nuclei, which are typical representatives of N = 52 and N = 53 nuclei, respectively, are described in the cluster–vibrational field coupling model in

natural representation (without parameter fitting). The interplay of few valence-shell neutrons and vibrational degree of freedom gives rise to the coexistence of quasivibrational, quasirotational, and clustering phenomena. (auth)

27619 EXCITATION FUNCTIONS FOR α-PARTICLE REACTIONS WITH MOLYBDENUM ISOTOPES. Graf, H. P.; Muenzel, H. (Kernforschungszentrum, Karlsruhe, Ger.). J. Inorg. Nucl. Chem.; 36: No. 12, 3647-3657(Dec 1974).

Excitation functions for (α, xn)-reactions x = 1, 2, 3 and (α, pxn)-reactions x = 0, 1, 2 with Mo-isotopes were measured, using the Karlsruhe isochronous cyclotron. Thin foils of natural molybdenum served as targets. For some reactions enriched Mo-isotopes were irradiated using copper as a monitor. The experimental results were compared to calculations, based on the statistical model. (auth)

27620 NUCLEAR DENSITY DISTRIBUTIONS AND RELATED PROPERTIES. Stock, H. (Frankfurt Univ. (F.R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 237: No. 3, 365-381(20 Jan 1975).

A fairly simple energy functional for the binding energy is presented leading to density distributions for protons and neutrons in the atomic nucleus. The distributions decrease smoothly to zero and have different ranges for protons and neutrons. The expected trends for several nuclear properties, such as binding energies and radii, result correctly. (auth)

27621 A COMPARISON OF BLAUGRUND AND MONTE CARLO LINESHAPE CALCULATIONS. Hanson, W. G.; Robertson, B. C. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Physics). Nucl. Instrum. Methods; 122: No. 3, 447-450(15 Dec 1974).

A systematic comparison of Blaugrund and Monte Carlo lineshape calculations is presented. The conditions under which the Blaugrund calculation can be expected to produce acceptable results are indicated. Similar results for centroid shift calculations are also indicated. (auth)

27622 LOW-LYING STATES IN ^{95}Tc STUDIED WITH THE ^{93}Nb(α,2nγ)^{95}Tc REACTION. Shibata, T.; Itahashi, T.; Wakatsuki, T. (Osaka Univ., Toyonaka (Japan). Dept. of Physics). Nucl. Phys., A; 237: No. 3, 382-398(20 Jan 1975).

Low-lying states in ^{95}Tc were studied with the ^{93}Nb(α,2nγ)^{95}Tc reaction. The level scheme was obtained from the $\gamma-\gamma$ coincidence measurement. The spin assignment was made on the basis of the observed γ-ray angular distributions and the excitation functions. The 337-keV $^7/_2^+$, 627-keV ($^5/_2^+$), 882-keV $^{13}/_2^+$ and 957-keV $^{11}/_2^+$ states, and possibly the 1265-keV $^9/_2^+$ state, are found to be strong candidates for the core multiplet states $[(1g_{9/2})_J \otimes 2^+]_J$. These states are discussed in terms of a weak-coupling model and the dressed three-quasiparticle model. The observed γ-ray angular distributions are compared with expectations based on a simple deexcitation model of the (α,2nγ)reaction. (auth)

27623 THE DOUBLY ODD NUCLEUS ^{144}Pm. I. Energy Levels. Macphail, M. R.; Summers-Gill, R. G. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics). Nucl. Phys., A; 237: No. 2, 285-299(13 Jan 1975).

The excited states of ^{144}Pm have been investigated for the first time by means of the proton-transfer reactions ^{143}Nd(^{3}He,d) and ^{143}Nd(α,t). Also reported are the results of high-resolution singles and coincidence studies of the γ-rays produced in the reactions ^{141}Pr(α,n) and ^{144}Nd(p,n). Twelve low-lying levels have been identified up to an excitation of 514 keV. Following a gap of more than 300 keV in which no levels are observed, the level density increases again. (auth)

27624 ELASTIC AND INELASTIC SCATTERING OF 51.9 MeV PROTONS BY DOUBLY EVEN TELLURIUM NUCLEI. Matoba, M.; Hyakutake, M. (Kyushu Univ., Fukuoka (Japan)); Yagi, K.; Aoki, Y. (Osaka Univ. (Japan)). Nucl. Phys., A; 237: No. 2, 260-274(13 Jan 1975).

Measurements of elastic and inelastic proton scattering by isotopically enriched targets of ^{122}Te, ^{124}Te, ^{126}Te, ^{128}Te and ^{130}Te have been carried out with a 51.9-MeV proton beam. In all isotopes, differential cross sections were measured for five to nine excited states up to 3-4 MeV excitation energy. Optical-model analyses are made of the elastic scattering, and best-fit optical-model parameters are obtained. Inelastic scattering data are analyzed by distorted-wave Born-approximation (DWBA) calculations using a complex form factor. Deformation parameters are obtained and compared with perviously measured values. For the elastic scattering and one-phonon 2^+ and 3^- states, coupled-channel calculations ($0^+-2^+-3^+$) are made. Finally, the splitting of the octupole strength, the hexadecapole vibration and the possible 2^5 pole vibration in even tellurium nuclei are discussed. (auth)

27625 STATISTICAL DECAY OF GAMMA RAYS IN (n_{th},γ) REACTIONS. Nardi, E.; Moretto, L. G.; Thompson, S. G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., A; 237: No. 3, 419-428(20 Jan 1975).

Isomer ratios obtained in doubly even targets in the (n_{th},γ) reaction are calculated using realistic level densities and spin cut-off parameters. The calculations were performed using the Monte Carlo method, and the general agreement between the present calculations and experimental data is satisfactory. In one case the shape of the γ-ray spectrum was calculated, and good agreement with experimental data was obtained. (auth)

27626 COMPUTER RECONSTRUCTION SCHEME OF NUCLEAR LEVELS WITH CONSIDERATION OF THE INTENSITY OF γ TRANSITIONS. Brumistrov, V. R. pp 190-204 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (Ed.). Moscow; Atomizdat (1974). (In Russian).

Results are reported on the development of the algorithms for a program for the reduction of nuclear levels from the γ spectra with consideration of the intensity of the γ quanta. The method is based on the combination of the energy of γ quanta and the energy of known levels. Simplified variations of the algorithms were programmed on the BESM-4 and polished on simulated spectra and on the spectra of actual isotopes. Recommendations are made on the use of the program developed. (JSR)

27627 INITIAL STAGE OF FRAGMENTATION IN SPHERICAL NUCLEI. Vdovin, A. I.; Solov'ev, V. G.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 6, 1131-1138(Dec 1974). (In Russian).

The role of fragmentation (i.e., the distribution of the strength of a one-particle or many-particle, one-phonon or many-phonon state over many nuclear levels) in complicating the structure of excited states with energy is discussed. The role of the interaction of quasi-particles with phonons in the fragmentation is shown. The initial stage of the fragmentation in even-even spherical nuclei is studied. (5 figures, 1 table) (auth)

27628 DECAY OF ^{93}Tc AND ^{93}Tc*. Anton'eva, N. M.; Barkov, A. V.; Zolotavin, A. V.; Zarubin, P. P.; Makarov, V. M.; Padalko, V. Yu.; Polkopaev, Yu. N.; Sergienko, V. A. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1757-1762 (Aug 1974). (In Russian).

The γ, conversion electron, and positron spectra of ^{93}Tc ($T_{\frac{1}{2}}$ = 2.73 h) and the γ spectra of ^{93}Tc (43 min) were studied. More precise and complete decay schemes for these isotopes were proposed. (1 figure, 3 tables) (tr-auth)

27629 DECAY OF ^{99}Rh($T_{\frac{1}{2}}$ = 16.1 DAYS). Anton'eva, N. M.; Barkov, A. V.; Vinogradov, V. M.; Zolotavin, A. V.; Katykhin, G. S.; Makarov, V. M.; Shablinskii, A. G. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1748-1756 (Aug 1974). (In Russian).

The γ spectra, $\gamma-\gamma$ coincidences, internal conversion electrons, and β^+ emission of ^{99}Rh ($T_{\frac{1}{2}}$ = 16.1 days) were studied, and a level scheme for ^{99}Ru was discussed. (1 figure, 4 tables) (tr-auth)

27630 WEAK β AND γ TRANSITIONS IN THE DECAY OF ^{95}Zr AND ^{95}Nb* AND ^{95}Nb^g. Anton'eva, N. M.; Barkov, A. V.; Zolotavin, A. V.; Katykhin, G. S.; Makarov, V. M.; Sergeev, V. O. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1741-1747(Aug 1974). (In Russian).

The γ spectra, internal conversion electrons, and β spectra of ^{95}Zr, ^{95}Nb*, and ^{95}Nb^g were measured in an attempt to detect the weak β and γ transitions in the decay of these isotopes. The values obtained were tabulated and included in the decay schemes of the isotopes. (5 figures, 6 tables) (JSR)

27631 IONIZATION (SHAKE-OFF) EFFECT ACCOMPANYING THE INTERNAL CONVERSION PROCESS IN THE K SHELL OF THE ATOM. Klyuchnikov, A. A.; Feoktistov, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1656-1660(Aug 1974). In Russian).

The structure of the K conversion lines of the γ transitions of 96.27 keV (M4) in ^{97}Tc, 204.00 keV (M1 + E2) in ^{95}Mo, and 778.22 keV (E2) in ^{96}Mo was studied by using a high-resolution β spectrometer. The spectra obtained are given and show groups of lines corresponding to the distribution of K conversion electrons accompanying the ionization (shake-off) of electrons from different shells of the atom. The upper limits of intensity of these groups are evaluated. (4 figures, 1 table) (JSR)

27632 ATTENUATION OF THE DOPPLER SHIFT IN THE ENERGY OF γ LINES. Lemberg, I. Kh.; Pasternak, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz., 38: No. 8, 1600-1616(Aug 1974). (In Russian).

Theoretical and experimental studies on the Doppler-shift attenuation in the energy of γ lines are reviewed in some detail.

The differences in the lifetimes measured by different investigators are discussed, and possible causes for the differences are examined. The results obtained at the Physico-Technical Institute in a systematic study of the Doppler-shift attenuation in γ lines arising as a result of Coulomb excitation are reviewed. The values obtained for 30 isotopes are tabulated and compared with the results obtained by others. (10 figures, 6 tables) (JSR)

27633 NUCLEAR ORIENTATION STUDIES AT LOW TEMPERATURES. Daly, P. W. Vancouver, B. C.; Univ. of British Columbia (1973). 137p.

Thesis.

The interaction between the nuclear magnetic moment and the hyperfine field in ferromagnetic and antiferromagnetic materials was used to orient radioactive nuclei at low temperatures. The measurement of the resulting angular distribution of the gamma radiation has yielded a variety of information in both nuclear and solid state physics. The ^{59}Fe nucleus in an iron sample was studied in an attempt to verify a report by Tschanz and Sapp (1970) who measure an unexpectedly large effect in the gamma ray distribution from that nucleus oriented in double nitrate salts. The anisotropy of gamma radiation emitted in the decay of ^{103}Ru oriented in ferromagnetic iron was measured to determine the magnetic moment of the isotope and to resolve mixing ratios in the decay scheme. The techniques of nuclear orientation were also used to serve the spin-flip transition in antiferromagnetic $MnCl_2 \cdot 4H_2O$. The nuclear orientation of ^{207}Bi in cobalt was studied to determine the hyperfine field. (MGH)

27634 PRE-EQUILIBRIUM PROCESSES IN (n,α) AND (p,α) REACTIONS. Caplar, R.; Kulisic, P. (Rudjer Boskovic Inst., Zagreb). Fizika, Suppl. (Zagreb); 6: 13(1974).

From proceedings of Yugoslav nuclear physicists meeting; Zlatibor, Yugoslavia (29 May 1973).

The modified formula for the normal preequilibrium process was used to fit the spectra in the (p,α) reaction on gold-197 at 40 MeV and on some other heavy nuclei. It is shown that the sum of evaporation and normal precompound emission gives a good description of the low and medium energy spectrum shape. This tends to indicate the importance of alpha particle emission from heavy nuclei. The analysis of the (n,α) reaction on praseodymium-141 and holmium-165 at 14 MeV shows that the preequilibrium emission in the A region seems to be mainly due to the preformed alpha particles, while other types of mechanism seem to play a minor role. (JFP)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 25828, 27520, 27590, 27601, 27620, and 27634.

27635 NUCLEAR LIFETIME MEASUREMENTS OF SOME EXCITED STATES IN ^{187}Re. Darwish, S. M. (Cairo Univ., El Mansura (Egypt). Faculty of Science); Svensson, L. G.; Lindskog, J.; Solhed, H.; Jonsson, N. G. (Uppsala Univ. (Sweden). Fysiska Institutionen). Nucl. Phys., A; 236: No. 2, 340-348(30 Dec 1974).

Earlier measurements on half-lives of the 686 keV, 625 keV and 618 keV levels in ^{187}Re have shown remarkable disagreements. The main object of this investigation has been to remeasure these half-lives by means of the delayed coincidence method utilizing a long-lens electron–electron spectrometer. The half-lives of these levels were measured as being, for the 686-keV level, $T_{\frac{1}{2}}$ = 10 ± 3 ps; 625-keV level, $T_{\frac{1}{2}}$ = 548 ± 20 ps; 618-keV level, $T_{\frac{1}{2}}$ < 50 ps. (auth)

27636 THE DECAYS OF 21.55 MIN ^{162g}Tm AND 24.3 S ^{162}Tm (A NEW ISOMER). De Boer, F. W. N.; Goudsmit, P. F. A.; Meijer, B. J.; Koldewijn, P.; Konijn, J.; Beetz, R. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). Nucl. Phys., A; 236: No. 2, 349-378(30 Dec 1974).

The decay of the 21.55-min ground state and of the 24.3-s isomeric state of ^{162}Tm was investigated with semiconductor detectors. The γ-ray spectrum was investigated with a Compton-suppression Ge(Li)–NaI(Tl) arrangement. A Si(Li) detector, mounted in an electron transport solenoid, was used to investigate the conversion electron spectrum. Three-dimensional coincidence measurements were performed with large-volume Ge(Li) detectors. The ^{162}Tm ground state has spin–parity 1^- and Nilsson assignment p[411]↓–n[521]↑. An allowed β transition (log ft ~6.4) was observed to a 2^-, 2 octupole vibrational level at 1572.84 keV. The Q-value determined from positron–gamma coincidence measurements is 4705 ± 70 keV. The discrepancy of the experimental K/β^+ ratio with theoretical predictions might possibly be explained by a large number of unobserved weak γ-rays besides the total of 315 stronger ones observed in this study. The average β-strength function was calculated to be 1.2×10^{-5}. Among the 50 levels observed in the decay, the 2^+, 4^+ and 6^+ members of the ground-state band, the 2^+, 3^+ and 4^+ members of the γ-band, several 0^+ and 2^+ members of the K = 0 β-bands and 1^-, 2^- and 3^- octupole vibrational levels were identified. Parameter values $Z_\gamma(0)$ and $Z_\gamma(2)$, determining the mixing between the γ-band and the ground-state band, allow no conclusive evidence about unequalness of the intrinsic quadrupole moments of the ground states and the γ-band. The Z(0) parameters, determining the mixing between the β-bands and the ground-state band, and X parameters, determining the ratio of E0 to E2 transition probabilities, were deduced. A previously unreported 24.3-sec isomer in ^{162}Tm was observed to decay in 10% of the cases by an allowed unhindered (log ft = 4.7) β-ray transition to a level at 1712.20 keV in ^{162}Er. The Nilsson configurations assigned to the isomeric and 1712.20-keV levels are $\{p[523]\uparrow + n[521]\uparrow\}_{5+}$ and $\{n[523]\downarrow + n[521]\uparrow\}_{4+}$, respectively. The isomeric level decays in 90% of the cases by an E3 transition (E_{IT} < 125 keV) to a $\{p[404]\downarrow - n[521]\uparrow\}_{2-}$ level at 66.90 keV in ^{162}Tm, which decays by an (M1 + <40% E2) transition to the 21.55-min ^{162}Tm 1^- ground state. (auth)

27637 THE SPECTRUM OF γ-RAYS FROM THE ^{182}W(n,n'γ) REACTION WITH REACTOR FAST NEUTRONS. Demidov, A. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii); Ahmed, M. R.; Al-Najjar, S.; Al-Amili, M. A.; Al-Assafi, N. (Iraq Atomic Energy Commission, Baghdad. Nuclear Research Inst.). Nucl. Phys., A; 237: No. 1, 125-141(6 Jan 1975).

The γ-ray spectrum of ^{182}W has been measured to estimate how much information about levels of doubly even non-spherical nuclei can be obtained in the study of the γ spectrum from the inelastic scattering of reactor fast neutrons. About 130 γ transitions have been observed in the spectrum, half of which were unknown previously. The de-excitation of the first three rotational bands in the spectrum manifests itself as a sharply defined group of intense γ lines. The de-excitation of the ^{182}W levels detected in the (d,d') and (d,t) reactions has been analyzed. The possibility of introducing previously unknown levels of $K = 0^+$, 2^+, 1^- bands at energies of 1.8–2.0 MeV has been considered. (auth)

27638 A STUDY OF THE DISTRIBUTION OF PARTIAL RADIATIVE WIDTHS AND AMPLITUDES FOR ^{149}Sm(n,γ)^{150}Sm. Becvar, F.; Chrien, R. E.; Wasson, O. A. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Phys., A; 236: No. 1, 198-224 (23 Dec 1974).

A new approach to the study of width distributions is developed. The approach makes use of level–level interference effects in (n,γ) reactions to produce a set of radiative width amplitudes. This set is compared to the width distribution and to the hypothesis of Porter and Thomas for the case of ^{149}Sm(n,γ)^{150}Sm. Both width and amplitude distributions show small but significant deviations from the hypothesis for transitions to low-lying 3^+ and 4^+ states in ^{150}Sm. No significant width correlations are observed, nor is there apparent any violation of the assumption of random phases for the amplitudes. (auth)

27639 AN INVESTIGATION OF LEVELS IN ^{150}Sm BY THE ^{149}Sm(n,γ)^{150}Sm REACTION. Becvar, F.; Chrien, R. E.; Wasson, O. A. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Phys., A; 236: No. 1, 173-197(23 Dec 1974).

The ^{149}Sm(n,γ)^{150}Sm reaction has been examined as a function of neutron energy in the range 0.04 eV to 34 eV at the Brookhaven National Laboratory high flux beam reactor. By using a time-of-flight technique, capture γ-ray intensities have been measured both on and between 16 resonances in this region. Resonance spins and level spins and parities in ^{150}Sm up to 2196.7 keV in excitation energy have been deduced from the data. Several new pin and parity assignments have been made. All positive-parity levels below 1820 keV are assigned to quasi-rotational bands. The level structure of ^{150}Sm is shown to be strikingly similar to that of ^{152}Gd. (auth)

27640 SPINS OF LOW-ENERGY NEUTRON RESONANCES IN ^{175}Lu, ^{189}Os AND ^{187}Os. Namenson, A. I.; Stolovy, A.; Smith, G. L. (Naval Research Lab., Washington, D. C. (USA)). Nucl. Phys., A; 237: No. 1, 45-63(6 Jan 1975).

Resonances up to 300 eV in ^{175}Lu, ^{189}Os, and ^{187}Os are reported together with spin assignments and probabilities of correctness. Those spins reported with better than 90% confidence consist of 49, 17, and 10 resonances in ^{175}Lu, ^{189}Os, and ^{187}Os, respectively. In ^{187}Os, 39 of the observed resonances have not been reported previously. Ratios of low-energy γ-ray intensities and γ-ray multiplicity were used for spin determination. A method developed previously for analyzing these data has been extended to include analysis of uncertainties in relative populations, average reduced neutron widths, and strength functions of the two spin groups. The

data in ^{183}Os are consistent with a $2J + 1$ level-density dependence, but in the other two isotopes this rule is violated. Spin cut-off factors of about 3 are suggested in this mass region. Small differences in $\langle 2g\Gamma_n^0 \rangle$ and in the strength functions for the two spin groups are not considered very significant. (auth)

27641 INFLUENCE OF CORIOLIS COUPLING ON THE N = 5 ORBITALS IN THE ODD-MASS DYSPROSIUM NUCLEI. Nyboe, K.; Straume, O. (Univ. of Bergen). Phys. Norv.; 7: No. 3, 145-160(1974).

The influence of the Coriolis coupling on the N = 5 orbitals in the odd mass dysprosium nuclei varies strongly from one nucleus to another. Most of the discrepancies between the unperturbed theoretical cross sections and the experimental cross sections are explained by including the Coriolis interaction in the cross section calculations. (auth)

27642 HALF-LIFE OF ^{155}Eu. Daniels, W. R.; Barr, D. W.; Grisham, G. F.; Lawrence, F. O. (Los Alamos Scientific Lab., NM). J. Inorg. Nucl. Chem.; 36: No. 12, 3874-3875(Dec 1974).

Incidental to the investigation of routine radiochemical problems, several ^{155}Eu sources have been produced by methods that are described. Decay of these samples has been followed for up to eight years and the preliminary value of 4.9 year (Meyer et al., Nucl. Phys.; A132: 177 (1969) for the half-life of ^{155}Eu has been revised to 4.68 ± 5 yr. (auth)

27643 MOMENT OF INERTIA AND VIBRATION ENERGY CALCULATIONS OF DEFORMED NUCLEI UNDER CENTRIFUGAL STRETCHING IN THE RARE EARTH REGION. Rai, D. S. (Government Postgraduate Coll., Bilaspur, India). Indian J. Phys.; 48: No. 6, 529-536(Jun 1974).

The β-vibration band-head energy was calculated for even-even nuclei in the rare earth region on the basis of the nonrigid rotator model of Gupta. The ratio of rotational and β-vibrational energy was expressed as an asymptotic series, and its values were determined up to $J^\pi = 10^+$. Under the assumption that the nuclear moment of inertia is modified due to centrifugal stretching for a prolately deformed nucleus, a simple equation was developed for the angular momentum-dependent moment of inertia, and values obtained with this equation were compared to those of other authors. The proposed relation was found to be reasonably correct. (2 tables) (auth)

27644 ROTATIONAL BANDS IN ^{185}Os AND ^{187}Os. Sodan, H.; Fromm, W. D.; Funke, L.; Kaun, K. H.; Kemnitz, P.; Will, E.; Winter, G. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)); Berzins, J. (AN Latvijskoj SSR, Riga. Inst. Fiziki). Nucl. Phys., A; 237: No. 2, 333-353(13 Jan 1975).

The excited states of the odd-neutron nuclei ^{185}Os and ^{187}Os were investigated by in-beam γ-ray measurements using the reactions ^{183}W(α,2n), ^{187}Re(d,2n) and ^{187}Re(p,n). High-resolution singles γ-ray spectra and $\gamma-\gamma$ coincidence spectra were measured. In addition, excitation functions and angular distributions of the γ-rays were determined for ^{185}Os. From the measurement of the delayed γ-radiation and the results of the $\gamma-\gamma$ coincidence experiments, two isomers were found in ^{185}Os at energies of 102.3 and 275.7 keV. They were interpreted, quite similar to the known isomers in ^{187}Os, as being the Nilsson states $^7/_2^-$ [503] and $^{11}/_2^+$ [615], respectively. Furthermore, in ^{185}Os the rotational states built on the ground state $^1/_2^-$ [510] up to spin $^{25}/_2$ as well as the rotational bands built on the two isomeric states and on the $^9/_2^+$ [624] configuration were found. Interband transitions between some members of the bands based on the configurations $^1/_2^-$ [510] and $^7/_2^-$ [503] in ^{185}Os indicated a strong mixing of the two $I = ^{13}/_2$ rotational members, which are very close in energy. This mixing of states with a difference of 3 units in the K quantum number was described by a Coriolis-coupling calculation including only first-order matrix elements. Further calculations were performed to describe the $^1/_2^-$ [510] ground-state band and the strongly perturbed $^{11}/_2^+$ [615] band. In ^{187}Os, the rotational bands belonging to the Nilsson states $^7/_2^-$ [503] and $^{11}/_2^+$ [615] were followed up to spin values of $^{17}/_2$ and $^{19}/_2$, respectively. (auth)

27645 PRECISE DETERMINATION OF E2 AND E4 MOMENTS IN ^{165}Ho FROM MUONIC X RAYS. Powers, R.J. (California Institute of Technology, Pasadena, California 91125); Boehm, F.; Vogel, P.; Zehnder, Z.; King, T.; Kunselman, A.R.; Roberson, P.; Martin, P.; Miller, G.H.; Welsh, R.E.; Jenkins, D.A. Phys. Rev. Lett. 34: No. 8, 492-495 (24 Feb 1975).

The quadrupole and hexadecapole moments of ^{165}Ho were derived from the hfs of the 3*d* muonic states. The resulting values are $Q_0 = 7.44 \pm 0.07$ *b* and $\Pi_0 = 0.52 \pm 0.10$ *b*^{2}. The parameters of the nuclear charge distribution were determined. An indication for an angular variation of the skin thickness was found. (auth)

27646 K AND L SHAKEOFF PROBABILITY IN ^{151}Sm. Freedman, M.S.; Beery, D.A. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 37: No. 7, 406-409 (17 Feb 1975).

We have measured the K-electron-emission probability for the 76-keV β decay of ^{151}Sm and obtain $P_K = (2.4 \pm 0.3) \times 10^{-6}$. We correct an earlier measurement to $P_K = (2.3 \pm 0.3) \times 10^{-6}$. From the agreement with the Law-Campbell shakeoff-plus-shakeup prediction, 2.2×10^{-6}, the direct collision contribution to the K emission is limited to $\sim 1/3$ of the Feinberg prediction, contrary to recent claims. We obtain an L-x-ray probability due to L-electron shakeoff per β decay of $(5.4 \pm 1.0) \times 10^{-4}$, about half the theoretical value, and also some indication that L shakeoff is predominantly L_1. (auth)

27647 PHYSICAL CAUSE OF BACK BENDING IN THE PLOT OF THE MOMENT OF INERTIA AGAINST THE ROTATION FREQUENCY. Grin', Yu. T. (I. V. Kurchatov Atomic Energy Institute). JETP Lett. 20: No. 7, 231-232 (5 Oct 1974).

It is shown that the cause of the back bending in the plot of the moment of inertia against the rotation frequency is a restructuring of the ground-state wave function due to the appearance of two-quasiparticle excitations. Expressions are obtained for the rotation frequencies at which the back bending takes place in the ground and β-vibrational bands. (auth)

27648 PARAMETERS OF DEFORMATION OF RARE-EARTH NUCLEI. Kurepin, A. B.; Topil'skaya, N. S. (Inst. of Nuclear Research, Moscow). Yadern. Fiz.; 20: No. 6, 1117-1121(Dec 1974). (In Russian).

The data on the quadrupole and hexadecapole deformations obtained from the experiments on inelastic scattering of moderate-energy charged particles and from the investigation of electromagnetic processes are analyzed. It is concluded that all the data at the start and at the end of the rare-earth nuclear region are consistent. The observed discrepancy for the nuclei at the middle of the rare-earth region gives an idea of the difference of the shape of the mass and charge distributions of nuclei at large deformations. (auth)

27649 CROSS SECTIONS FOR RADIATIVE NEUTRON CAPTURE IN 5 TO 80 keV ENERGY REGION FOR Yb ISOTOPES. Shorin, V. S.; Kononov, V. N.; Poletaev, E. D. (Physico-Engineering Inst., Moscow). Yadern. Fiz.; 20: No. 6, 1092-1095(Dec 1974). (In Russian).

The mean cross sections for neutron capture by $^{171-174, 176}$Yb isotopes at 5 to 80 keV were measured with respect to the cross section for the reaction ^{10}B(n, $\alpha\gamma$)^{7}Li and to the Au capture cross section at 30 keV neutron energy. The Hauser-Feshbach statistical theory was used to obtain the strength functions $\overline{S}_l$ for p neutrons and the radiative strength functions $\overline{\Gamma}\gamma/\overline{D}$. (2 figures, 1 table) (auth)

27650 ISOMERIC E5 TRANSITION OF ^{184}Re*. Gavrilyuk, V. I.; Klyuchnikov, A. A.; Kupryashkin, V. T.; Makovetskii, Yu. V.; Feoktistov, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1653-1655(Aug 1974). (In Russian).

The existence of the 188.01-keV E5 isomeric transition was confirmed by precise measurements in this area of the conversion spectrum of ^{184}Re*. The L_{II} and L_{III} lines of this transition were detected, and an upper limit for the intensity of the L_I line was determined. The intensity of the conversion lines for the 83.28-keV γ transition was also measured, and the multipolarity was found to be M4 with a possible admixture of E5 no greater than 0.01%. These results were compared with the experimental and theoretical studies of others. (2 figures) (JSR)

27651 MOMENT OF INERTIA CALCULATIONS FOR SOME EVEN-EVEN RARE EARTH NUCLEI. Rai, D. S. (Government Post Graduate Coll., Bilaspur, India). Indian J. Phys.; 48: No. 7, 577-584(Jul 1974).

A comparative study of various formulations, based on three different models, viz., cranking model, centrifugal stretching model and governor model, for the angular momentum dependent moment of inertia was made. Two other formulations based on these models and their comparative merits were also discussed. On the basis of the nonrigid rotator model a new formula was proposed for the variation of moment of inertia with angular momentum. Rare-earth even-even nuclei were considered throughout the treatment. (auth)

27652 MEASUREMENT OF THE ENERGY AND RELATIVE INTENSITY OF THE $K\alpha_1$ HYPERSATELLITE LINE IN ^{169}Tm. Javahery, R.; van Eijk, C. W. E.; van Krugten, H.; van Nooijen, B. (Delft Univ. of Tech., Netherlands). Phys. Rev., A; 10: No. 6, 1921-1923(Dec 1974).

A measurement, carried out with a curved-crystal spectrometer, of the K x rays of thulium emitted in the K capture of ^{169}Yb has revealed the existence of a weak line which may be identified as the $K\alpha_1$ (Tm) hypersatellite line. The energy shift amounts to 1.04 ± 0.01 keV and the intensity of the hypersatellite line relative

to the intensity of the $K\alpha_1$ (Tm) line is $(7.6 \pm 3.8) \times 10^{-5}$. The value of the energy shift agrees nicely with the shifts measured in other isotopes; the relative intensity is roughly in agreement with the value that may be expected on the basis of experimental data for other isotopes. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 25875, 26963, 27094, 27520, 27552, 27557, 27601, 27602, 27620, 27625, 27640, 27659, 27671, 27672, and 27760.

27653 (BNL-50439) EVALUATED NEUTRON CROSS SECTIONS OF ^{197}Au. Mughabghab, S. F.; Prince, A.; Goldberg, M. D.; Bhat, M. R.; Pearlstein, S. (Brookhaven National Lab., Upton, N. Y. (USA)). Oct 1974. Contract AT(30-1)-16. 42p. (ENDF-215). Dep. NTIS $4.00.

The resonance parameters used in the evaluation are first tabulated and discussed. Then smooth neutron cross sections are presented: total, elastic, capture, inelastic scattering, (n,2n), (n,3n), (n,p), and (n,α) cross sections are given in appropriate energy regions from thermal to 20 MeV. Angular and energy distributions for secondary neutrons are also included. (29 figures, 1 table) (RWR)

27654 (CONF-7209124-, pp 320-337) POSSIBILITIES TO MEASURE NEUTRON CROSS SECTIONS IN THE NEUTRON ENERGY REGION 1 μeV-1 MeV. Bally, D. (Inst. of Atomic Physics, Bucharest). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

A brief presentation of different experimental methods used for neutron cross section measurements in the energy region below 1 MeV is done. For this energy region, two experimental setups are proposed: in the first one, moving sample is used; in the second, a moving crystal is used as a "slow neutron monochromatic source." The efficency and the physical limitations of these experimental procedures are discussed. (16 figures) (auth)

27655 (JINR-P-6-7582) INVESTIGATION OF THE ^{191}Tl → ^{191}Hg → ^{191}Au DECAY. Vandlik, Ya.; Zaitsev, N. G.; Mateh, Z.; Makhunka, I.; Tyrroff, Kh.; Fenesh, T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 14p. (In Russian). INIS.

By means of Ge(Li)- and Si(Li)-spectrometers a study was carried out on the spectra of gamma rays and conversion electrons occurring during decay of ^{191}Tl. The gamma spectrum of ^{191}Hg, the daughter isotope of ^{191}Tl, was also investigated. In the gamma spectrum of ^{191}Tl ($T_{\frac{1}{2}} = 5.22 \pm 0.16$ min) a total of 17 gamma transitions were found, among which 11 are new. The half-life of the ground state of ^{191}Hg (49 ± 10 min) was determined. (tr-SJR)

27656 ROTATIONAL BANDS IN THE LIGHT ODD-MASS Tl NUCLEI. Newton, J. O.; Stephens, F. S.; Diamond, R. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., A; 236: No. 1, 225-251(23 Dec 1974).

The odd-mass nuclei $^{191-197}$Tl have been formed in a variety of (HI,xn) reactions and studied by in-beam spectroscopic techniques. The decay of the high-spin Pb isomers, also formed in (HI,xn) reactions, leading to $^{193-197}$Tl has also been investigated. Evidence is presented for the existence of levels of the previously proposed $^9/_2^-$[505] rotational bands in the nuclei. Tentative evidence is given for the existence of oblate rotational bands, based on the $^{13}/_2^+$[606] state, in $^{191-195}$Tl. (auth)

27657 A J-FORBIDDEN ISOMERIC TRANSITION IN ^{204}At. Gippner, P.; Kaun, K. H.; Neubert, W.; Schulze, W.; Stary, F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). Nucl. Phys., A; 237: No. 1, 142-148(6 Jan 1975).

An isomeric 587.3-keV transition was investigated using several target-ion combinations: ^{197}Au + ^{12}C, ^{193}Ir + ^{16}O and ^{196}Pt + ^{15}N. From the measured excitation functions for the ^{193}Ir(^{16}O,xn)$^{209-x}$At reaction it follows that this transition belongs to ^{204}At. The isomeric level is ascribed to the 10^- state of the configuration $\pi(h_{9/2})^3\nu(i_{13/2})^{-1}$. (auth)

27658 THE PROTON OPTICAL-MODEL POTENTIAL NEAR THE COULOMB BARRIER. Eck, J. S. (Kansas State Univ., Manhattan (USA)); Thompson, W. J. (North Carolina Univ., Chapel Hill (USA)). Nucl. Phys., A; 237: No. 1, 83-92(6 Jan 1975).

Proton elastic scattering data from ^{197}Au, ^{208}Pb and ^{209}Bi at energies near the Coulomb barrier are analyzed. The energy dependence of the real volume and imaginary surface-derivative potential depths, V_R and W_{SF}, of a local optical-model potential with fixed geometric parameters are found to be much more rapid than at higher energies. The strong energy dependence of V_R near the Coulomb barrier is explained in terms of the non-locality of the nucleon-nucleus interaction. (auth)

27659 PARITY OF THE GROUND STATE IN ^{192}Ir. Subotovich, M.; Sarzhimski, Ya. (Univ. Marie Curie, Lublin). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 4, 778-779(Apr 1974). (In Russian).

From 23rd annual conference on nuclear spectroscopy and nuclear structure; Tbilisi, USSR (29 Jan 1973).

The $\beta-\gamma$ correlations during the decay ^{192}Ir → ^{192}Pt were studied in order to determine the nature of the β transitions and parity of the ground state of ^{192}Ir. The parity of the ground state of ^{192}Ir was discussed on the basis of previous results. It was concluded that for determination of the parity of the ground state of ^{192}Ir very precise and special experimental investigation and proof are necessary. (INIS)

27660 DESIGN AND ANALYSIS CONSIDERATIONS IN SMALL ANGLE NEUTRON SCATTERING. Rimawi, K.; Benenson, R. E. (State Univ. of New York, Albany (USA)). Nucl. Instrum. Methods; 123: No. 1, 195-198(1 Jan 1975).

Corrections are described for electron screening of the nuclear Coulomb field, for the finite areas of scatterer and detector, and for multiple scattering from samples of rectangular shape. (auth)

27661 HELIUM ION-INDUCED FISSION OF ^{203}Tl AND ^{205}Tl AT 31, 42, AND 65 MeV. Kieburtz, R. D.; Neuzil, E. F. (Western Washington State Coll., Bellingham). J. Inorg. Nucl. Chem.; 36: No. 12, 3643-3645(Dec 1974).

A radiochemical study has been made of the alpha particle-induced fission of ^{203}Tl and ^{205}Tl using 31, 42 and 65 MeV helium ions. The fission fragment mass distribution curves of ^{203}Tl and ^{205}Tl are Gaussian-shaped with values of the width at half-maximum of 15 ± 1 amu and 15 ± 1 amu at 31 MeV, 18 ± 1 amu and 17 ± 1 amu at 42 MeV, and 16 ± 1 amu and 19 ± 1 amu at 65 MeV, respectively. The total fission cross sections after being corrected for isotope effects were determined as 10.4 μbarn and 6.5 μbarn at 31 MeV, 429 μbarn and 334 μbarn at 42 MeV, and 37,540 μbarn and 4520 μbarn at 65 MeV, respectively. The outstanding feature of these results is the consistently lower value of σ_f for the fission of ^{205}Tl as compared to ^{203}Tl. This is especially evident for the values of 65 MeV. This may be due in part to the formation of a magic number of neutrons in the compound nucleus ^{209}Bi. (auth)

27662 SEARCH FOR ULTRADENSE NUCLEI IN RELATIVISTIC COLLISIONS OF Ar ON Pb. Price, P.B.; Stevenson, J. (Department of Physics, University of California, Berkeley, California 94730). Phys. Rev. Lett. 34: No. 7, 409-412 (17 Feb 1975).

In 2.5×10^6 interactions of 1.1- to 1.6-GeV/nucleon ^{40}Ar ions with a Pb target we saw no tracks of products with $Z>20$ ejected in the beam direction, using a Lexan detector stack. The upper limit on the formation cross section is about 50 nb for products with $26 \lesssim Z \lesssim 40$ and increases with Z to about 1.5 μb for Z = 100. (auth)

27663 EFFECT OF NUCLEAR DEFORMATION ON HIGH-ENERGY PROTON-NUCLEUS SCATTERING. Chao, A.W.; Goldhaber, A.S. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794). Phys. Rev. D 11: No. 1, 29-35 (1 Jan 1975).

In order to determine the effect of ellipsoidal nuclear deformation on diffractive proton-nucleus scattering, an accurate computational scheme is developed, starting from the high-energy optical model. Numerical results are compared with data on p-U (deformed) and p-Pb (spherical) scattering at 19.3 GeV, obtained by Bellettini *et al.* Contrary to earlier speculations, it is concluded that the deformation effect is barely visible in this experiment. Multiple Coulomb scattering produces a more dramatic blurring of the data than the intrinsic contribution of nuclear shape. (auth)

27664 SECONDARY RADIATION ACCOMPANYING β DECAY OF ^{203}Hg. Batkin, I. S.; Smirnov, Yu. G.; Chernigin, A. S. (Voronezh State Univ., USSR). Yadern. Fiz.; 20: No. 6, 1088-1091(Dec 1974). (In Russian).

The spectrum of the inner brehmsstrahlung accompanying the β decay was measured for the nucleus ^{203}Hg, and the experimental probability of the K-shell autoionization was determined. The results are compared with calculations using the formulae by Lewis and Ford, Migdal, and Levinger. The experimental probability of the autoionization is in agreement with the theoretical predictions. An essential influence of screening on the spectrum of the inner brehmsstrahlung from ^{203}Hg is indicated. (2 figures) (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 27620, 27663, 27694, 27725, and 27738.

27665 (CONF-7209124-, pp 338-340) ABSOLUTE DETERMINATION OF ^{235}U AND ^{239}Pu FISSION CROSS-SECTION FOR 2200 M/SEC NEUTRONS. Borcea, C.; Borza, A.; Buta, A. (Inst. of Atomic Physics, Bucharest). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

27666 (CONF-730923-, pp 127-134) SELF-CONSISTENT CALCULATIONS OF FISSION BARRIERS. Flocard, H.; Quentin, P.; Vautherin, D. (Institut de Physique Nucleaire, Orsay, France). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Some constrained Hartree–Fock calculations of the deformation energy curve of ^{240}Pu, performed with Skyrme's interaction, are presented. Parameters used were chosen to reproduce nuclear masses and deformations. A constraint on the quadrupole moment Q was adopted to generate fission energy curves. An approximate treatment of pairing correlations was included. Deformation energy curves are plotted, and the values of the quadrupole and hexadecapole moments of the ground state are given. (3 figures, 1 table) (RWR)

27667 (JINR-P4-8394) SUBCOULOMB REACTIONS ON ACTINIDE REGION NUCLEI. Gareev, F. A.; Shul'ts, G.; Yamaleev, R. M.; Puzynin, I. V.; Puzynina, T. P.; Kukhtina, I. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The subcoulomb reactions $^{238}U(d,p)^{239}U$ and $^{238}U(d,t)^{237}U$ were analyzed at incident energies of the deuterons from 8 up to 12 MeV by means of a coupled channel calculation. The obtained results show that with respect to the simple DWBA the inclusion of inelastic processes in both the initial and the exit channel improves the description of the observed energy dependence of the cross sections. (auth)

27668 (N-74-28151) FISSION PRODUCTS OF SUPER-HEAVY ELEMENTS. An Investigation of the Naturally Occurring Fission Products of Elements Heavier Than Uranium. Final Report, 1 April 1971–1 April 1972. Marti, K. (California Univ., La Jolla, San Diego (USA). Dept. of Chemistry). 1972. 7p. (NASA-CR-138798). NTIS $4.00.

Fission mass yields in different structural elements and mineral separates were studied for the element X. The fission component for ^{244}Pu and the element X are discussed along with radiogenic ^{129}Xe and neutron activation. (STAR)

27669 THE $^{232}Th(\gamma,n)^{231}Th$ CROSS SECTION NEAR THRESHOLD. Mafra, O. Y.; Cesar, M. F.; Renner, C. (Instituto de Energia Atomica, Sao Paulo (Brazil)); Goldemberg, J. (Sao Paulo Univ. (Brazil). Instituto de Fisica). Nucl. Phys., A; 236: No. 1, 1-9(23 Dec 1974).

The partial photoneutron cross section of ^{232}Th was measured by activation methods using monochromatic γ-rays of energies from 5.43 to 10.83 MeV. The measured cross section shows structure similar to the one observed previously in the photofission cross section. The implications of these observations on the photoabsorption structure of ^{232}Th are discussed. (auth)

27670 ON THE URANIUM K = 0 BANDS SEEN IN TWO-NUCLEON TRANSFER REACTIONS. Soerensen, B. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., A; 236: No. 1, 29-44(23 Dec 1974).

It is shown that the calculated (p,t) and (t,p) strengths of excited K = 0 bands in uranium isotopes depend strongly on details of the single-particle spectrum. The inclusion of inelastic effects in the reaction calculation is necessary in order to get reliable differential cross sections. Contrary to suggestions in the literature, the observation of strong two-nucleon transfer strength to an excited 0^+ state cannot in itself be taken as evidence for the presence of a new degree of freedom. However, the simultaneous study of stripping and pickup reactions along the entire isotope chain may provide new insight in the nature of the residual interaction. (auth)

27671 ELECTRONUCLEAR METHOD OF NEUTRON PRODUCTION. Barashenkov, V. S.; Toneev, V. D.; Chigrinov, S. E. At. Energ. (USSR); 37: No. 6, 475-479(Dec 1974). (In Russian).

The previously described Monte Carlo method of calculating the multiplication of neutrons produced by high-energy protons on heavy metal targets was modified by using a more precise model of intra-nuclear cascades which takes into account the competitive processes of fission and evaporation of excited residual nuclei. The calculated results for lead and uranium are in close agreement with experimental data. A comparison with the results obtained by other authors is made. The major difference with the conclusions drawn in previous work lies in a 10 to 20% decrease both in the energy release in uranium and in the average number of neutrons produced. (4 figures, 2 tables) (auth)

27672 INTERACTION OF HIGH-ENERGY DEUTERON BEAMS WITH MATTER. Barashenkov, V. S.; Toneev, V. D.; Chigrinov, S. E. At. Energ. (USSR); 37: No. 6, 480-483(Dec 1974). (In Russian).

A statistical model to describe the meson–nucleon cascade induced by high-energy deuterons in fissile matter is proposed. Inelastic nuclear interactions are described by using a cascade-evaporation model, which takes into account the competitive processes of evaporation and fission of excited nuclei. Data on the total neutron yield and heat release in big chunks of uranium at various energies of primary deuterons are presented. Thus, when deuteron energy, T, is increased from 0.3 to 2 GeV. The heat release and neutron yield in the target increase by more than an order of magnitude. When T = 0.3 and 1 GeV a deuteron beam produces in a uranium target 1.5 and 1.3 times more neutrons, respectively, than a proton beam of the same energy and intensity; however, when T ≥ 2 GeV, the neutron yield in both cases turns out to be practically the same. The calculated results are in close agreement with available experimental data. (4 figures, 2 tables) (auth)

27673 INDEPENDENT YIELD OF ^{138}Cs FROM THERMAL-NEUTRON-INDUCED FISSION OF ^{249}Cf. Eichor, M.; Troutner, D. E. (Univ. of Missouri, Columbia). J. Inorg. Nucl. Chem.; 36: No. 12, 3880-3882(Dec 1974).

In an earlier report (Troutner et al., J. Inorg. Nucl. Chem.; 34: 801 (1972)) the fractional independent yields of ^{134}I, ^{136}Cs and ^{140}La from thermal-neutron-induced fission of ^{249}Cf were compared with those from fission of ^{233}U and ^{235}U. All of these fission products are odd-odd and 81- or 83-neutron nuclides. However, facilities at the reactor did not permit separation of fission products at times much shorter than one hour. In a new series of experiments it is possible to make separations at much shorter times, and the yield of another odd-odd 83-neutron nuclide, ^{138}Cs from ^{249}Cf fission has been measured. Experimental details are given and results discussed. (UK)

27674 FISSION OF ORIENTED U^{235} NUCLEI. Gonin, N.N.; Goryunov, V.K.; Kozlovskii, L.K.; Rabotnov, N.S.; Stavisskii, Yu. Ya.; Tambovtsev, D.I. JETP Lett. 20: No. 7, 229-231 (5 Oct 1974).

We present the results of the measurements of the angular anisotropy of the fragments in the fission of oriented U^{235} nuclei by thermal neutrons and by neutrons of energy E_n=10, 50, 80, 100, and 150 keV. At the neutron energies 50, 80, and 150 keV we measured also the anisotropy on nonoriented nuclei. The experimental results are compared with data by others. The observed anisotropies are interpreted within the framework of the existing model representations of nuclear fission. (auth)

27675 ENERGY SPECTRUM OF POSITRONS PRODUCED IN NUCLEAR INTERACTIONS AT $R < R_{cr}$. Marinov, M. S.; Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 6, 1223-1228(Dec 1974). (In Russian).

The energy spectrum is calculated for positrons produced in collisions of heavy nuclei with charges $Z_1 + Z_2 > Z_c$, when the ground level of the discrete spectrum dives into the lower continuum. In the case where the positrons that are produced in scattering of the nuclei at a fixed angle θ are detected, the spectrum has a sharp peak near the upper boundary $T = T_{max}$. Presence of the peak is favorable in view of the possibility of detecting the effect experimentally. (5 figures, 2 tables) (auth)

27676 INVESTIGATION OF α-DECAY OF ^{249}Bk. Baranov, S. A.; Shatinskii, V. M. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 8-11(Jan 1975). (In Russian).

Alpha decay of the isotope berkelium-249 is investigated by aid of a magnetic α-spectrograph. The energies and intensities of ten α-groups are determined. An energy level scheme of the ^{245}Am nucleus is derived on basis of the experimental data. The existence of three rotational bands with the quantum characteristics $5/2^-$ [523↓], $5/2^+$ [642↑], and $7/2^+$ [633↑] is mentioned. (auth)

27677 DECAY OF ^{226}Ac. Vakhtel, V. M.; Vylov, Ts.; Golovkov, N. A.; Dzhelepov, B. S.; Ivanov, R. B.; Lyatushinski, A.; Mikhailova, M. A.; Mozzhukhin, A. V.; Sergeev, V. O.; Chumin, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1639-1647 (Aug 1974). (In Russian).

The α-particle, x-ray, and γ-ray, and conversion electron spectra arising during the decay of ^{226}Ac were measured. It was established that the α decay of ^{226}Ac, if it exists, is $\leq$0.01% of the decays. The intensities of the β^- decay and e capture are 82.8 ± 1.6% and 17.2 ± 1.6%, respectively. On the basis of the intensity balance for ^{226}Th and ^{226}Ra levels, the lg ft for the components of the β spectra and electron capture were determined for the low-lying 0^+, 2^+, and 1^- levels of ^{226}Th and ^{226}Ra. $I^\pi = 1^-$ was assigned to the ground state of ^{226}Ac. (4 figures, 2 tables) (tr-auth)

27678 NUCLEAR STRUCTURE EFFECT IN THE INTERNAL CONVERSION PROCESS OF THE 42-KEV TRANSITION IN ^{249}Bk. Ramaniah, K. V.; Reddy, T. S.; Reddy, K. V. (Andhra Univ., Waltair, India). Indian J. Phys.; 48: No. 7, 668-670(Jul 1974).

The δ^2-λ diagram for the 42-keV transition in berkelium-249 is used to determine the values of the penetration parameter for M1 conversion and E2 admixture for the 42-keV transition. Also relative experimental errors are shown for the L subshell ratios. It is found that good overlap occurs for the subshell ratios. The fact that the L value is significantly different from unity in this case explains the anomaly in the experimental subshell ratios and accounts for the nuclear structure effects in the internal conversion process of the studied transition. (JFP)

27679 EXPERIMENTAL DETERMINATION OF PHOTOFISSION NEUTRON MULTIPLICITIES FOR EIGHT ISOTOPES IN THE MASS RANGE 232 ≤ A ≤ 239. Caldwell, J. T.; Dowdy, E. J. (Los Alamos Scientific Lab., NM). Nucl. Sci. Eng.; 56: No. 2, 179-187(Feb 1975).

The prompt- and delayed-neutron multiplicities for photofission of the eight isotopes ^{232}Th, ^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, and ^{239}Pu were measured by using bremsstrahlung with endpoint energies ranging from 8 to 13 MeV. The measured multiplicities are compared with those from the same compound nucleus formed in neutron-induced fission where such data exist. (auth)

Nuclear Theory

Refer also to abstracts 27150, 27229, 27292, 27413, 27464, 27525, 27565, 27577, 27615, 27627, 27647, and 27658.

27680 (CEA-CONF-2625) DWBA ANALYSIS OF DIRECT TRANSFER REACTIONS INDUCED BY HEAVY IONS. Extended Seminar on Nuclear Physics, Trieste, Italy, 17 September–21 December 1973. Mermaz, M. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1973. 71p. (CONF-7309126-).

The first part of this lecture is devoted to the general behavior of the reaction mechanism for heavy-ion collisions. The semiclassical considerations which govern the reaction mechanism are investigated. Then one-nucleon-transfer reactions are discussed; they are considered as a way to check in detail the reaction mechanism as the single particle states are well known through direct transfer reactions induced by light projectiles like d, t, or ^{3}He. Finally, the study of two- and four-nucleon transfer reactions induced by heavy ions like ^{16}O is presented. The importance of calculation of a microscopic form factor is pointed out, and several examples to illustrate the spectroscopic information that has been obtained so far from multinucleon transfer reactions are given. Only direct surface transfer reactions are included in the analysis. These studies show clearly that dynamical effects such as Q-value dependence and angular momentum mismatch are very important and are well taken into account by a simple DWBA treatment including recoil effects. (24 figures, 8 tables) (RWR)

27681 (CONF-7209124-, pp 75-138) ROLE AND EFFICIENCY OF NUCLEAR MODELS IN NUCLEAR DATA EVALUATION. Benzi, V. (CNEN, Bologna). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

Two extreme pictures can be used to describe the nuclear reaction, the compound-nucleus process and direct reaction. These models may be used whenever the details of the many-body interactions can be ignored; hence, the resonance energy region is not considered in this work, except for those aspects which are linked with the estimate of those parameters that are required by the models. After a short introductory section, the main features of the optical model and the statistical model—the models used most frequently as tools in evaluation—are reviewed. Section headings are as follows: The optical model: outline of the model, the phenomenological potential, parametrology, deformed nuclei, optical model and evaluation, a few remarks on the collective inelastic scattering, and optical model codes; The statistical model: outline of the model, radiative capture and fission, Weisskopf–Ewing model, parametrology, statistical model and evaluation (inelastic scattering, radiative capture, fission, charged and multiple particle emission), and statistical model codes. (14 figures, 3 tables) (RWR)

27682 (CONF-730923-) INTERNATIONAL SYMPOSIUM ON CORRELATIONS IN NUCLEI, BALATONFURED, HUNGARY, 3–8 SEPTEMBER 1973. Nemeth, J. (ed.). (Eotvos Lorand Fizikai Tarsulat, Budapest (Hungary)). 1974. 467p.

Separate abstracts were prepared for each of the 40 papers in this volume. (RWR)

For abstracts of individual papers see: 27408, 27577, 27666, and 27683–27719.

27683 (CONF-730923-, pp 5-22) SKYRME INTERACTION IN NUCLEAR THEORY. Moszkowski, S. A. (Univ. of California, Los Angeles). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Some applications of the Skyrme interaction to problems in nuclear structure theory are discussed. The interaction is taken to act only in relative S states, and it is extended to a density-dependent form; its density dependence term is chosen to be a three-body delta interaction. The main part of the paper begins with the calculation of gross properties of spherical nuclei, mainly ground-state energies. First N = Z nuclear matter and nuclei are considered, and then N ≠ Z nuclear matter and nuclei. Binding energies and root-mean-square radii are tabulated for ^{16}O, ^{40}Ca, ^{48}Ca, ^{90}Zr, and ^{208}Pb. The inclusion of spin dependence is examined, and the parameters in the "droplet model" nuclear mass formula are discussed. Then the use of the Skyrme interaction for calculation of single-particle potentials is briefly taken up; it has had only mixed success. The effective interaction is very important in shell-model studies of the properties of low-lying nuclear states; the effect of density dependence and pairing matrix elements are addressed. Hartree–Fock and harmonic oscillator results are compared for ground-state energy, rms radius, and single-particle energies in ^{40}Ca. In conclusion, work with a generalized Skyrme interaction is reviewed. (5 tables) (RWR)

27684 (CONF-730923-, pp 23-27) CORRELATIONS WITHOUT TEARS. Jackson, A. D. (State Univ. of New York, Stony Brook); Lande, A. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

For purposes of evaluating matrix elements of relatively weak interactions in the presence of the strong nucleon–nucleon interaction it is convenient to construct an effective weak operator, defined ultimately in terms of a t matrix. Effective weak operators may be constructed simply if t(E) can be reliably approximated as a low-rank separable operator. It has been shown [Nucl. Phys., A191, 177 (1972)] that such representations of rank 2 yield defect wave functions, and thus effective operators, of sufficient accuracy for purposes of nuclear physics for the soft-core $^1S_0$ interaction of Reid and the uncoupled $^3S_1$ interaction of Malfliet and Tjon. This work extends these techniques to the coupled $^3S_1$–$^3D_1$ Reid potential. Tabulated eigenvalues of the Reid potentials constructed at $E_0 = -20$ MeV indicate that no rank-2 form provides a quantitative approximation to $t(E_0)$. Defect wave functions obtained are shown. (1 figure, 1 table) (RWR)

27685 (CONF-730923-, pp 29-40) DIRECT VARIATIONAL CALCULATION OF TWO-BODY DENSITY MATRIX AND A CALCULATION OF PARTICLE–HOLE STATES DETERMINED BY TWO-BODY DENSITY MATRIX OF THE GROUND STATE. Mihailovic, M. V. (Univ. of Ljubljana, Yugoslavia). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Two methods for using the two-body density matrix to describe the properties of an N-body system are described. The variational approach to the density matrix offers a lower bound on energy and thus is complementary with the modern variational approaches (projected Hartree–Fock (PHF), generator-coordinate method) which give an upper bound. The calculation on schematic models provides an energy closer to the ground state than the PHF and the N-projected BCS methods. The Hermitian operator method (HOM) is developed to calculate the particle–hole states by using the two-body density matrix as input. Where comparison is possible, the HOM usually gives better agreement with experiment and exact calculation than the extended RPA. When both methods are used together, they provide rather good approximate particle–hole excited states. The results of calculations of the ground state

and some excited states of several systems are presented; methods for schematic Lipkin's and pairing models and for rather realistic models of ^{8}B, ^{12}C, $^{15,16,17}O$, ^{20}Ne, and ^{28}Si were tested. (7 tables) (RWR)

27686 (CONF-730923-, pp 41–48) MICROSCOPIC DETERMINATION OF THE CHARGE EXCHANGE POTENTIAL. Nemeth, J. (Nuclear Physical Lab., Oxford); Fai, G. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Proton scattering from a double-closed-shell nucleus is considered; only the scattering and charge-exchange terms are retained. The formalism to define the charge-exchange potential starting from two-body forces is deduced; the Lane equations are obtained. Then results are presented for the $^{40}Ca + p$ scattering case using a density-dependent effective interaction. Since the overlap between proton and neutron wave functions is very large (even for ^{208}Pb), one can always calculate in good approximation the charge-exchange potentials as the difference of the Hartree–Fock equivalent local neutron and proton potentials in the given states. (2 figures) (RWR)

27687 (CONF-730923-, pp 49-58) CALCULATIONS OF THE IMAGINARY PART OF THE OPTICAL POTENTIAL. Satchler, G. R. (Oak Ridge National Lab., TN). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Some phenomenological calculations on the imaginary part of the optical potential are recounted and placed in the context of other work; these calculations attempt to gain some insight into the contributions to the imaginary potential for protons, deuterons, and alpha particles from open inelastic and pickup or stripping channels. It is shown that it is easy to reproduce a measured absorption cross section; however, differential cross sections and partial wave amplitudes are generally in poor agreement with experiment. Data are shown for $^{40}Ca + p$ and $^{208}Pb + p$ at 30 MeV. (6 figures) (RWR)

27688 (CONF-730923-, pp 59-69) SUPERFLUID CORRELATIONS AND THE DYNAMICS OF NUCLEAR ROTATIONS. Mang, H. J. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

This note discusses various phenomena observed experimentally, such as backbending and decoupled or strongly distorted bands, on the basis of changing superfluid correlations. It is found that correlations that manifest themselves in nuclear deformations play an important role. The theoretical basis is the cranking model. A Hamiltonian consisting of a single-particle part and a quadrupole–quadrupole plus pairing interaction was used; results for ^{162}Er, ^{168}Yb, and ^{159}Dy are given in figures and a table. (4 figures, 1 table) (RWR)

27689 (CONF-730923-, pp 71-78) MICROSCOPIC THEORY OF COLLECTIVE MOTION IN TRANSITIONAL NUCLEI. Djolos, R.; Donau, F.; Kartavenko, V.; Janssen, D. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Quadrupole motion in even–even nuclei is discussed; quadrupole deformation is the dominant collective mode in such nuclei. Problems in attempting to explain experimental data with previous models are recalled. Then a model for the description of the collective quadrupole motion is devised; this description is a boson representation of fermion operators which is simply a boson realization of SU_6 algebra. The collective states are investigated in this model, and it is then applied to E2 transition probabilities in Mo isotopes and ^{152}Gd. (2 tables) (RWR)

27690 (CONF-730923-, pp 79-89) EFFECT OF CORRELATIONS ON THE STRUCTURE OF HOLES IN NUCLEI. Fritsch, W.; Lipperheide, R.; Wille, U. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Various aspects of the description of correlated holes in nuclei are discussed. Special attention is paid to the relationahip between the (phenomenological and microscopic) "quasi-hole" approaches and the fully microscopic spectral function theory. Integral properties of holes, like mean removal energies and spreading widths, and the effect of ground-state correlations are briefly considered. (auth)

27691 (CONF-730923-, pp 91-98) SINGLE-PARTICLE ENERGIES AND WAVE FUNCTIONS IN NUCLEI. Schaefer, L. (Univ., Heidelberg). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Calculations of the ground-state energy automatically yield single-particle (s.p.) energies and s.p. wave functions. The present status of the relation of these quantities to properties of the hole spectral function and thus to experiment, is briefly sketched. It is assumed that the spectral function can, in principle, be determined experimentally. S.P. energies in nuclear matter are discussed first, and these results are then extended to finite systems. (3 figures) (RWR)

27692 (CONF-730923-, pp 99-111) EFFECTIVE INTERACTION IN NUCLEI AND ITS DERIVATION FROM THE NUCLEON–NUCLEON FORCE. Schucan, T. H. (SIN, Villigen, Switzerland). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The question of whether the effective interaction in the nuclear shell model can be deduced from free two-nucleon interactions has been examined in recent years, and numerical calculations of the excitation spectra of nuclei with few valence particles have been done. All of these calculations are based on the folded-diagram perturbation expansion. This paper is devoted to the particularly important aspect of the convergence of the perturbation series. The definition of the effective interaction and its perturbation expansion are discussed. It is then shown that there are many possible choices for the effective interaction and that the standard choice in applications to the nuclear shell model has quite unfortunate implications for the convergence. In the last section another choice, based on Padé approximants, is discussed which seems to display much more promising convergence properties. (2 figures) (RWR)

27693 (CONF-730923-, pp 113-126) MICROSCOPIC THEORY OF COLLECTIVE MOTION. Baranger, M. (Massachusetts Inst. of Tech., Cambridge). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

A classical collective Hamiltonian, one with a kinetic energy and a potential energy expressed in terms of collective variables, is derived and then quantized. Applications possible include the oscillations of soft nuclei (neither vibrations nor rotations), fission, and fusion of heavy ions. The time-dependent Hartree–Fock approach is used. This talk was essentially a review of work discussed previously. (RWR)

27694 (CONF-730923-, pp 135-154) SEMI-SELFCONSISTENT ENERGY CALCULATION FOR STRONGLY DEFORMED NUCLEI. Kisdi, D. (Univ. for Technical Sciences, Budapest); Nemeth, J. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The constrained Thomas–Fermi equations for deformed nuclei are established, and the total energy of ^{240}Pu is mapped in the deformation space. The most stable shape is found not to be spherically symmetric, the value of the fission barrier in this approximation is 23 MeV. The single-particle Thomas–Fermi potential is proposed to be used for calculating the one-particle wave functions in strongly deformed nuclei in order to get a semi-selfconsistent approach to such nuclei. (3 figures, 1 table) (auth)

27695 (CONF-730923-, pp 155-164) FISSION: THEORY AND BEYOND (A STUDY OF COLLECTIVE DYNAMICS). Wilets, L. (Univ. of Washington, Seattle); Haff, P. K. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Problems in the dynamics of fission are discussed, with emphasis on the role of nuclear correlations. One aspect of dynamics is the determination of the inertial mass parameters, generally a tensor B_{ij}; this is appropriate for quasi-adiabatic processes. The other aspect is more general, and involves deviations from adiabaticity, excitation of single-particle levels, viscosity, etc. Quasi-adiabatic mass parameters are treated in the cranking model, in generator coordinates, and in the modified generator-coordinate method. (3 figures) (RWR)

27696 (CONF-730923-, pp 165-184) DENSITY-DEPENDENT FORCES WITHOUT RECOURSE TO NUCLEAR MATTER CALCULATIONS. Faessler, A. (Kernforschungsanlage, Juelich, Ger.); Tripathi, R. K.; Muether, H. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The thrust of this work is to apply the basic idea of the effective density-dependent forces directly to finite nuclei; this allows one to avoid several approximations, such as the local density approximation and approximations relating to the Brueckner reaction matrix. The following are the basic ideas: The Brueckner reaction matrix is calculated carefully. It depends on the density of the surrounding nucleons through the Pauli operator and the starting energy. An important ingredient for the success of the calculations is a variational principle which minimizes the total energy, not only as a function of the wave functions, but also as a function of the density contained in the effective force. The success of this variational principle may be connected with the fact that it defines the single-particle energies in such a way that this definition also includes off-shell insertions which are not included in the normal definition of the single-particle energies in the Brueckner–Hartree–Fock approach. After the theory is developed, results obtained for ^{16}O by using the Yale and Reid soft-core potentials are given and discussed. (6 figures, 1 table) (RWR)

27697 (CONF-730923-, pp 185-203) CORRELATION EFFECTS IN THE SPECTRA OF LIGHT NUCLEI. Irvine, J. M.; Mani, G. S.; Pucknell, V. I. E.; Vallieres, M.; Yazici, F. (Univ. of Manchester, Eng.). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

It is assumed that the observed nuclear states are eigenstates of a two-body Hamiltonian $H_0 = \Sigma_i - (\hbar^2/2m)\ \nabla_i^2 + \Sigma_{i>j} V_{ij}$. The object of the work is to carry out configuration-mixing calculations of such accuracy that the discrepancy between the results and experiment will indicate the magnitude of possible errors arising from the above assumption. The Reid potential is used as a realistic bare nucleon–nucleon interaction. A set of correlated variational basis functions is approximated by a cluster expansion, where the constraint on the correlation parameters was that the uncertainty introduced by stopping at the two-body cluster terms was less than 20%. It is shown that, with a purely spatial Jastrow correlation, it is impossible to obtain either the absolute binding energies of the light nuclei (A = 2 to 8) and nuclear matter or the relative spectroscopic energies of the light nuclei. However, with the introduction of a simple tensor correlation, it is possible to reproduce all these energies to high accuracy. (14 figures, 4 tables) (RWR)

27698 (CONF-730923-, pp 205-216) EFFECTIVE THREE-BODY FORCES IN TRUNCATED SHELL-MODEL CALCULATIONS. Barrett, B. R. (Univ. of Arizona, Tucson); Halbert, E. C.; McGrory, J. B. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The determination of effective Hamiltonians to be used in shell-model calculations in a truncated vector space was studied in a series of calculations in which a direct connection was made between a fixed Hamiltonian, H, which "describes" the eigenenergies and eigenvectors of nuclei in a given mass range in some "large" shell-model vector space, S, and an effective Hamiltonian, "H_s" to be used to "describe" some of the eigenvalues and eigenvectors of the same nuclei in a smaller (truncated) vector space, "S." The results of the H-in-S model play the role of "experimental observables" to be reproduced by the "H'-in-"S" model. The following three methods were used for constructing "H": lowest-order perturbation theory; a projection technique, by which an operator, "H_s," in the truncated space, "S," is constructed in terms of known eigenvalues and eigenvectors in the larger space, S; and a least-squares search to fit to selected large-space eigenenergies. The experimental single-particle energies for A = 17 and the renormalized Kuo interaction were used to calculate the eigenenergies and eigenvectors of nuclei with A = 18 to 20 in the full sd shell, i.e., ($d_{\frac{5}{2}}$,$s_{\frac{1}{2}}$,$d_{\frac{3}{2}}$). The space was then truncated to ($d_{\frac{5}{2}}$,$s_{\frac{1}{2}}$), and the above techniques were used to construct effective Hamiltonians in this smaller space. Effective 3-body forces in A = 19 and 20 nuclei were investigated. Since the projection method exactly reproduces in the truncated space the selected large-space eigenenergies, the effective Hamiltonian determined by this method indicates how large an effective 3-body term is needed. It was found that the effective 3-body terms computed by the projection method were fairly large in magnitude and slightly non-Hermitian. When the number of valence nucleons is increased beyond 2, a 3-body term exists in the effective Hamiltonian, "H_s" and is needed in order to obtain accurate agreement with the experimental spectra. However, this 3-body term in "H" is generally smaller than the 2-body part of "H_s" so that the (1+2)-body part of "H" gives the basic qualitative features of the 3-particle spectrum. Lowest-order perturbation theory is unsuccessful in accurately reproducing the 3-body part of "H_s." Finally, the least-squares-fitted (1+2)-body effective Hamiltonian appears to be more successful in reproducing the experimental spectra for 3 or 4 valence nucleons than the lowest-order perturbation-theory and projection-method Hamiltonians since the former contains the influence of the effective 3- and 4-body forces in some average way. (5 figures, 1 table) (RWR)

27699 (CONF-730923-, pp 217-224) SEMI-REALISTIC EFFECTIVE HARTREE–FOCK INTERACTION WITH SKYRME-TYPE DENSITY DEPENDENCE. Pearson, J. M.; Rouben, B.; Saunier, G. (Univ. of Montreal). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The possibility of using the Hartree–Fock method as a means of extrapolating from known to unknown nuclei makes it worth while to follow a phenomenological approach in which the effective interaction is fitted directly to known nuclei. An example of this approach is the Skyrme-type force of Vautherin and Brink (VB), in which the density dependence is simulated by a zero-range three-body force. The two-body part of this force is likewise zero-range and also velocity dependent. An effective interaction was devised in which there is still phenomenological freedom but which bears a much closer relationship to the real force. In the even states the interaction takes the form $V^+ = V^+_{OBEP} + V^+_{PHEN}$, where the first term is the even-state mesonic potential of Bryan and Scott, cut off at 1 fm, and the second term is a short-range phenomenological term. The odd-state force takes the purely phenomenological form of VB. Binding energies and radii are calculated for magic nuclei, along with properties of nuclear matter. (1 figure, 1 table) (RWR)

27700 (CONF-730923-, pp 225-228) CORRELATION STRUCTURE OF THE WAVE FUNCTION AND THE EXPANSION OF THE GROUND-STATE ENERGY OF NUCLEAR MATTER. Schaefer, L. (Univ., Heidelberg). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The ground-state wave function of an N-fermion system can be written in exp(S) or product ansatz. While equivalent, these two representations imply different definitions of "irreducible" n-body correlations. The difference in the explicit correlation structure of the representations has remarkable consequences for the theory of the ground-state energy. This is demonstrated by use of the cluster expansion of the energy expectation value. A comparison of Brueckner- and Jastrow-type calculations has indicated that the effect discussed is numerically important: it possibly yields an additional attraction of several MeV per nucleon. (RWR)

27701 (CONF-730923-, pp 229-237) SHORT-RANGE CORRELATIONS AND PARITY MIXTURES IN NUCLEI. McKellar, B. H. J. (Univ. of Melbourne). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Two recently investigated reactions, $^{16}O(2^-;\ 8.88\ MeV) \rightarrow {}^{12}C + \alpha$ and $n + p \rightarrow d + \gamma$, give results which present theory finds impossible to reconcile with each other. Previous work on this problem is sketched. In the present work attention is directed to the nuclear physics involved in the calculations; in particular, to the short-range correlations which must play a large role in determining the result. Simple models are described, and the detailed results are given. The second reaction above is of importance in unraveling the structure of the $\Delta S = 0$ nonleptonic weak interaction because it permits disentanglement of the $\Delta T = 0$ and $\Delta T = 1$ parts of the interaction. The demand that the parity amplitude be left invariant by a phase shift-equivalent transformation forces severe restrictions on the transformation—it must be a relatively high-order polynomial, and this leads to short-range wiggles in the transformed wave function. Results for the γ asymmetry in the reaction $^{19}F(\frac{1}{2}^-;\ 110\ keV) \rightarrow {}^{19}F(\frac{1}{2}^+;\ g.s.) + \gamma$ are given. (1 table) (RWR)

27702 (CONF-730923-, pp 239-255) BHF THEORIES: APPROACH TO REALITY? Kuemmel, H.; Schelongowski, W.; Zabolitzky, J. G. (Ruhr-Univ., Bochum, Ger.). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Different versions of BHF theories (BHF, RBF, DHF, with different choices for single-particle potentials, etc.) are discussed and compared. It is argued that there is so much freedom in the choice of different versions of the theory that almost any value for binding energy and rms radius in the neighborhood of the experimental data can be obtained. This viewpoint is supported by new numerical results obtained by the Bochum group, including the new

super-soft core potential by Toureil and Sprung and Bethe–Faddeev calculations with triple self-consistency. (3 figures, 1 table) (auth)

27703 (CONF-730923-, pp 257-280) EFFECT OF CORRELATIONS ON SUM-RULES, ESPECIALLY FOR NUCLEAR MONOPOLE AND DIPOLE VIBRATION. Lane, A. M. (Atomic Energy Research Establishment, Harwell, Eng.). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The nuclear charge monopole mode plays an essential role in determining the isospin-mixing effects of the Coulomb force. These effects appear in many important areas of nuclear physics: corrections to superallowed ft values, corrections to the isobaric mass formula including the Coulomb displacement of analog states, damping width of analog states, etc. For initial orientation on the monopole problem, one can try the shell model or the hydrodynamic model. Both have shortcomings. One can gauge the reliability of the shell model by referring to the parallel dipole problem, where one has experimental values of sum rules. The shell model does not fit these values; this result shows that correlation effects are important. A simple systematic method was developed for correcting sum rules for correlation effects. This method can be applied either to the total sums or to the separate isospin contributions. In the dipole case, the corrections to the shell-model values are of the right sign and magnitude to bring accord with the data. In the monopole case, estimates of the above Coulomb mixing effects are significantly changed by the corrections. The most striking result is that both the shell model and the corrected model give large second-order Coulomb shifts which make the Nolen–Schiffer anomaly much worse than generally believed in heavy nuclei. (auth)

27704 (CONF-730923-, pp 281-306) CLUSTER EFFECTS IN NUCLEAR REACTIONS. Hodgson, P. E. (Nuclear Physics Lab., Oxford). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

In many types of nuclear interactions groups of nucleons behave to some extent as if they were a single particle. Of all possible clusters the alpha particle is the most likely to be formed due to its high spatial and spin symmetry and binding energy; this paper is concerned mainly with the evidence for alpha-cluster effects in nuclear reactions. The model assumes that alpha clusters exist in the nucleus in definite orbits long enough to produce measurable effects. There is a close similarity between the nucleons and the alpha particles in the nucleus and their associated potentials. These similarities are found in several types of phenomena, and may all be treated with the same potential. In this review, the phenomena associated with elastic and inelastic scattering are considered first, followed by those in cluster transfer reactions. Then the information obtainable from knock-out reactions is discussed, and the paper concludes by treating the systematic behavior of the potentials. (7 figures, 2 tables) (RWR)

27705 (CONF-730923-, pp 313-318) VERY EXTENDED (PUFFY) STATES. Zimanyi, J. (Central Research Inst. for Physics, Budapest); Gyarmati, B. 1974.

From symposium on correlations in nuclei; Belatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The explanation of Wigner cusps can be found in the tail behavior of the neutron channel function, which becomes very extended near threshold. One can thus expect some peculiarities, not only in excitation curves of nuclear reactions, but in any case when the energy of the single-particle neutron component of the actual nuclear state is near threshold. The negative-energy "resonances" introduced to explain the very-low-energy neutron scattering cross sections having several eV binding energy are examples of such puffy states (the radial wave function drops to $1/e$ of its value at the nuclear surface in distances of the order of 10^3 fm). To investigate the effect of the underlying threshold state in various phenomena, its spreading on the actual nuclear states must be examined closely. In this work R-matrix theory is used to study the effects "puffy" states have in nuclear reactions. (4 figures) (RWR)

27706 (CONF-730923-, pp 319-327) CORRELATIONS IN RESONANCE REACTIONS. Moldauer, P. A. (Argonne National Lab., IL). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

A direct reaction due to correlated nuclear wave functions gives rise to correlations in partial resonance widths and to a nonresonant background cross section. It also enhances the magnitude of the fluctuation cross section, and thus increases the average reaction cross section by more than the usual direct reaction contribution. The relationships between these resonance correlation effects and direct reaction amplitudes are discussed. (1 table) (auth)

27707 (CONF-730923-, pp 339-343) ONE-BOSON-EXCHANGE-POTENTIAL, EFFECTIVE INTERACTION, AND STRUCTURE OF FINITE NUCLEI. Bleuler, K.; Machleidt, R.; Erkelenz, K.; Holinde, K. (Univ. of Bonn). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

An effective interaction for use in finite nuclei is defined and calculated by means of the Brueckner theory of nuclear matter. The free nucleon–nucleon interaction is a one-boson-exchange potential (OBEP). Outstanding features of this OBEP are relativistic effects like energy dependence, meson retardation effects, and the off-energy shell continuation according to covariant perturbation theory. The saturation properties of infinite nuclear matter were calculated in lowest-order Brueckner G matrix by using this OBEP and a variation of it. The effective interaction for the four spin–parity states derived from the OBEP's is shown. Energies per particle and rms charge radii are calculated for closed-shell nuclei; these calculations show that the OBEP explains the structure of finite nuclei at least as well as purely phenomenological potentials. (1 figure, 1 table) (RWR)

27708 (CONF-730923-, pp 345-368) THREE-BODY APPROACH TO THE EFFECTIVE NUCLEON–NUCLEON INTERACTION. Lovas, I. (Kernforschungsanlage, Juelich, Ger.); Vegh, L. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The problem of the nuclear effective interaction is attacked from the point of view of the three-body problem. In this approach the problem of the effective interaction is formulated in the language of integral equations; this procedure may circumvent some of the difficulties by approximating the kernels of the integral equations instead of involving perturbation theory. A possible formulation of the problem is presented, and attention is given to the interpretation of the quantities involved and the properties of the effective kernel. Despite the complexity of the equations, it is proved that exact solutions can be found for a class of models. Such a model is used to illustrate the method; exact and shell-model energies are compared. Suggestions for enlargement of the model are given. (4 figures) (RWR)

27709 (CONF-730923-, pp 369-383) EFFECT OF CORRELATIONS ON THE SCATTERING OF HIGH-ENERGY PARTICLES FROM NUCLEI. Feshbach, H. (Massachusetts Inst. of Tech., Cambridge). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Elastic scattering of ~1-GeV nucleons is considered. Pair and center-of-mass correlations are discussed, along with correlation lengths and correlation functions. An attempt to develop and apply a theory for the scattering of a high-energy particle which takes the overlapping potential into account is then described. The method used is a multiple scattering theory of the optical potential. Effects of the dynamical correlations on the calculated cross sections for elastic scattering of protons by ^{4}He at 1.69 GeV/c are shown. (6 figures) (RWR)

27710 (CONF-730923-, pp 385-395) PION–NUCLEUS OPTICAL POTENTIALS. Tabakin, F. (Univ. of Pittsburgh). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

As a step toward extracting nuclear correlations from pion–nucleus scattering data, a first-order optical potential for scattering near the 3-3 resonance region is presented in momentum space. The potential incorporates the important features of nuclear size, a properly transformed and bounded pion–nucleon amplitude, and some pion absorption. A coordinate-space nonlocal version of this optical potential is also given, and is found to yield a simple extension of the original Kisslinger potential in the limit of small nonlocality (or of small off-shell effect). The main feature of the new form is that it yields an appreciable build-up of back-angle scattering, which arises from using a pion-nucleon amplitude transformed to the pion–nucleus center-of-mass system. This build-up can and should be included before reliable extraction of correlations is made. (4 figures) (auth)

27711 (CONF-730923-, pp 397-400) AVERAGE DENSITY APPROXIMATION FOR NON-ZERO RANGE FORCES. Boschan, P. (Eotvos Univ., Budapest). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

An average density approximation to deal with non-zero-range density-dependent forces is discussed. Such effective interactions may be derived from realistic forces, by using the results of nuclear matter calculations and averaging over linear and angular momentum. The proposed averaging method is to integrate over the appropriate volume and divide by A. Calculations were done for ^{16}O and ^{40}Ca. (2 figures, 1 table) (RWR)

27712 (CONF-730923-, pp 401-406) CONTINUUM SHELL MODEL CALCULATIONS INCLUDING 2p-2h CONFIGURATIONS. Barz, H. W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Rotter, I.; Hoehn, J. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The purpose of this work was to show that difficulties arising in numerical shell-model calculations can be overcome if a coupled-channels method [Barz, Rotter, and Hoehn, Phys. Lett., 37B, 4 (1971)] is used. This method is based on the shell-model approach to nuclear reactions and on the Feshbach projection technique. The whole function space of the model is divided into two parts: the Q space contains the bound-state wave functions, while the P space is given by the scattering wave functions. On the basis of the model, investigations can be carried out in light nuclei where the resonances are not overlapping and the structure of the resonances may be understood in most cases in the approximation of the usual bound-state shell model. To study the correlation between the P and Q space in more detail, calculations were done for the $^{15}N(n,n)$ ^{15}N reaction. Positions and widths are tabulated for 1^- and positive-parity states in ^{16}N. (1 figure, 2 tables) (RWR)

27713 (CONF-730923-, pp 417-421) CORRELATIONS IN THE STRUCTURE OF LIGHT NUCLEI. Bleuler, K. (Univ. of Bonn). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Correlations in a large sense are needed in order to write nuclear wave functions in terms of single-particle functions, which in turn constitute the only practicable starting point for explicit calculations. Many different kinds of correlations must be considered simultaneously to obtain an overall wave function which corresponds reasonably well with reality. First considered are two-body correlations due to the repulsive core in nuclear forces. The correlation between the spins of two interacting nucleons due to the relatively large tensor force must be taken into account. Longer-range correlations include the pairing effects and the "core" structure of the nucleus; indeed, any number of nucleons which by themselves form a relatively strongly bound state will appear correlated or "clustered" with the hole structure. This work outlines a systematic method for the treatment of such general clustering, which appears most in the region of light nuclei. An example, a system composed of a core and a s.c. valence nucleon, which exhibits most of the typical and nontrivial features of clustering is discussed. (RWR)

27714 (CONF-730923-, pp 423-439) CENTER-OF-MASS MOTION EFFECTS IN HIGH-ENERGY ELECTRON AND HADRON SCATTERING BY LIGHT NUCLEI. Ciofi degli Atti, C. (Istituto Superiore di Sanita, Rome). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The problem of the center-of-mass (cm) motion in the shell model and many-body theories of nuclear physics is reviewed: center-of-mass motion and the nuclear Hamiltonian, shell-model phenomenological wave functions, many-body theories, center-of-mass corrections to the ground-state energy, and center-of-mass corrections to transition matrix elements are discussed. Numerical results concerning cm spuriosity effects in high-energy electron and hadron scattering by ^4He and ^{16}O are presented; shell-model and HF(BHF) wave functions are used in calculation of the charge form factors. Finally, the influence of spuriosity effects in the study of short-range correlations is briefly examined. (5 figures) (RWR)

27715 (CONF-730923-, pp 441-442) DENSITY-DEPENDENT EFFECTIVE INTERACTION DETERMINED VARIATIONALLY FROM THE FREE NUCLEON-NUCLEON POTENTIAL. Grypeos, M. E. (Univ. of Thessaloniki, Greece); Mavrommatis, E. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The effective interaction and correlation functions are discussed. Simplified trial correlation functions containing parameters can be constructed, and these trial functions can be used in determining the effective interaction by minimizing the energy per particle in nuclear matter. It was also found that the variationally determined effective interaction should fall off at large distances less rapidly than the free nucleon-nucleon potential; it was seen that V_{eff} tends to zero as the inverse of the eighth power of the interparticle distance. (RWR)

27716 (CONF-730923-, pp 443-444) JASTROW CORRELATIONS IN NUCLEAR MATTER WITHOUT TRUNCATION OF THE CLUSTER EXPANSION. Grypeos, M. E. (Univ of Thessaloniki, Greece). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

An approximate expression in "closed form" is derived for the (trial) energy per particle in nuclear matter. The undesirable truncation of the cluster expansion may thus be avoided. (auth)

27717 (CONF-730923-, pp 445-448) VELOCITY-DEPENDENT FORCES AND INELASTIC SCATTERING. Pearson, J. M. (Univ. of Montreal). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

The nonlocality of the effective force between the incident projectile and the target nucleons is discussed. Modification of selection rules arises naturally out of the formalism; this occurs with a purely central force, if it is momentum dependent. The latter part of the paper is devoted to giving some physical insight into the problem. (RWR)

27718 (CONF-730923-, pp 449-453) ISOSPIN AND OTHER CONSERVED QUANTUM NUMBERS IN COMPOUND NUCLEUS REACTIONS. Robson, D. (Univ. of Tallahassee); Richter, A.; Harney, H. L. 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Consequences of the isospin quantum number for compound-nucleus reactions are discussed, particularly with reference to statistical cross section fluctuations. First, the necessary formulas which have been derived on the basis of the Hauser-Feshbach and Ericson theories are summarized. Differences between these results and those of other workers are pointed out. Data on the statistical reactions $^{54}Cr(p,p)$ and $^{54}Cr(p,\alpha)$ show a difference between the coherence widths measured in the proton and α channels, which is attributed to the decay properties of states with difference isospin in the compound nucleus. The formalism developed for the isospin quantum number can be extended to other quantum numbers as well, e.g., angular momentum and parity. (RWR)

27719 (CONF-730923-, pp 455-457) QUASIFREE PROCESSES AND CORRELATION IN NUCLEI. Slaus, I. (Inst. Rudjer Boskovic, Zagreb). 1974.

From symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

In international symposium on correlations in nuclei.

Information on nuclear structure obtained through the study of quasi-free scattering processes is reviewed. Possible dependence of cross sections for different quasi-free processes on the detailed properties of the nuclei involved is discussed. (RWR)

27720 (JINR-E4-7645) UNITED DESCRIPTION OF THE EXCITED STATES OF ATOMIC NUCLEI. Soloviev, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 19p. (In Russian). INIS.

An analysis is carried out of the role of the average field, of interactions leading to pair correlations of the superconducting type, and of multipole-multipole interactions at different excitation energies. Consideration is given to the process of complicating the structure of states with an increase in excitation energy, and the assertion is made that the interaction of quasiparticles with phonons plays an important role in this process. The structure of a highly excited state is discussed, and a comparison with the compound-state introduced by N. Bohr is carried out. It is concluded that there is a general basis for describing low, intermediate and high excited states of atomic nuclei. (tr-SJR)

27721 (JINR-E-4-7754) APPROXIMATE SOLUTION OF THE EQUATIONS OF THE MODEL FOR THE DESCRIPTION OF HIGHLY EXCITED STATES OF DOUBLY EVEN DEFORMED NUCLEI. Kurchev, G.; Soloviev, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). INIS.

A previously proposed model is generalized to describe the states of intermediate and high-energy excitation of odd, deformed

nuclei in the case of even-even nuclei. The wave function contains one-, two-, three- and four-phonon terms. Use is made of an approximation method, which takes into account polar, noncoherent terms, to obtain approximate solutions of the model. The set of equations is reduced to a secular equation which does not contain superfluous solutions. The equations which were obtained can serve as a basis for investigating the structure of states of intermediate and high-energy excitation of even-even, deformed nuclei. (tr-SJR)

27722 (JINR-P4-7480) CALCULATION OF FORM FACTORS FOR THE TWO-NUCLEON CLUSTER TRANSFER. Bang, E.; Elin, T.; Shults, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 19p. (In Russian). INIS.

With an approximation of a binding of channels a method of calculating form factors is proposed for reactions involving the transfer of two nuclei. By this method it is possible to take into account the effects of clustering in two nucleons and to use realistic nuclear potentials. It is shown with the ^{12}C (t,p) ^{14}C reaction as an example that by means of the proposed method it is possible to give a good description of the corresponding angular distributions. (tr-SJR)

27723 EFFECTIVE RANGE PARAMETERS OF SEPARABLE POTENTIALS. Englefield, M. J. (Monash Univ., Clayton (Australia). Dept. of Mathematics). Nucl. Phys., A; 236: No. 2, 302-306(30 Dec 1974).

Formulas are obtained which express the effective range parameters of a rank-two separable potential as non-singular integrals of the form factors. These results are extended to allow for a Coulomb interaction. (auth)

27724 A NEW METHOD FOR DETERMINING THE ENERGY INDEPENDENT EFFECTIVE INTERACTION. Anastasio, M. R.; Hockert, J. W.; Kuo, T. T. S. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Phys. Lett., B; 53: No. 3, 221-223(9 Dec 1974).

A new algorithm for computing the effective interaction is presented. Its convergence properties are tested in two solvable models, and it is found to converge always and to be able to reproduce all the eigenvalues of the full Hamiltonian. (auth)

27725 A MICROSCOPIC, BUT NOT SELF-CONSISTENT APPROACH TO NUCLEAR BINDING AND DEFORMATION ENERGIES. Ko, C. M.; Pauli, H. C.; Brack, M.; Brown, G. E. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Nucl. Phys., A; 236: No. 2, 269-301(30 Dec 1974).

By using various versions of the Skyrme force and Negele's interaction, deformation energies of nuclei are calculated by evaluating the expectation value of the many-body Hamiltonian in wave functions taken to be antisymmetrized products of single-particle functions. These single-particle functions are eigenfunctions of a phenomenological potential, here taken to be a deformed Woods-Saxon well. The method can be thought of as an extension of the Strutinsky shell-correction method, to make the connection with the two-body interaction. The method employed here is checked by comparison with Hartree-Fock (HF) results; the method is, however, much faster than the HF method, and, therefore, suitable for a wide range of problems where one tests the sensitivity of results to changes in the two-body interaction. A fairly good agreement with the HF method is obtained for ground-state energies, radii and deformations, as well as for deformations of shape isomers. The main discrepancy is that the energies tend to increase slightly too rapidly with deformation, indicating that the best phenomenological well may not have been chosen. Two-dimensional energy surfaces, which agree quite well with those from the Strutinsky method, are found for ^{240}Pu. (auth)

27726 CAN THE 0^+ STATES OF EVEN SUPERFLUID NUCLEI BE DESCRIBED BY ANHARMONIC PAIRING VIBRATIONS? van Gunsteren, W. F.; Allaart, K. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.). Nucl. Phys., A; 236: No. 2, 317-326(30 Dec 1974).

States in even nuclei in which no pairs are broken may be described by a seniority zero (v = 0) shell model calculation. It is generally believed that such 0^+ states may also be understood in terms of anharmonic pairing vibrations. A microscopic description of such vibrations is given by the generator coordinate method (GCM) using the pairing gap as generator coordinate. Cases are especially considered where the ground state is superfluid, and it is found that for this state the GCM description provides a good approximation to the result of a v = 0 shell model diagonalization. For the excited states this is in general not the case. This is illustrated by results of two schematic models and the more realistic case of the Sn isotopes. It is shown that a much better approximation of the v = 0 states is obtained by performing a number-projected two-quasiparticle (2 q.p.) calculation. Therefore it is believed that the nature of these excited 0^+ states may be better understood from the 2 q.p. picture than from that of anharmonic pairing vibrations. (auth)

27727 ON THE EFFECT OF QUADRUPOLE PAIRING INTERACTION ON THE BACKBENDING BEHAVIOUR IN ROTATING NUCLEI. Krumlinde, J. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Matematisk Fysik); Szymanski, Z. (Institute of Nuclear Research, Warsaw (Poland)). Phys. Lett., B; 53: No. 4, 322-324(23 Dec 1974).

The influence of the quadrupole component in the nucleon-nucleon pairing force on the rotational nuclear motion is investigated with a simple model in connection with the backbending phenomenon. The inclusion of this component, although necessary in the realistic calculation, does not affect considerably the qualitative picture of the phenomenon. (auth)

27728 BOSON SYMMETRIES IN VIBRATIONAL NUCLEI. Iachello, F.; Arima, A. (Rijksuniversiteit Groningen (Netherlands). Kernphysisch Versneller Instituut). Phys. Lett., B; 53: No. 4, 309-312(23 Dec 1974).

It is proposed that nuclei (away from closed shells and from regions of large deformation) be described as a boson gas. By exploiting the underlying O(5) symmetry, analytic expressions for the eigenvalues of the boson Hamiltonian and for the transition matrix elements are obtained. The computed energy levels are in surprisingly good agreement with those recently observed in the $(\alpha,x n\gamma)$ and (heavy ion, $x n\gamma$) reactions. (auth)

27729 PION CONDENSATION IN NEUTRON STAR MATTER. II. Nuclear Forces and Stability. Au, C. K.; Baym, G. (Illinois Univ., Urbana (USA). Dept. of Physics). Nucl. Phys., A; 236: No. 2, 500-522(30 Dec 1974).

This paper presents several stable models of charged-pion-condensed neutron star matter. The non-relativistic limit of the chirally symmetric Weinberg Lagrangian is used to describe interactions of the condensed pion field with the nucleons, as well as the $\pi-\pi$ interactions of the condensed field. In the absence of nucleon-nucleon interactions, matter in this model is unstable, tending to ever-increasing baryon density and condensate wave vector. The connection of this model of condensation with the σ-model is shown. A general framework for including nuclear forces is then laid out. Results are given for a simple model in which the nuclear forces are assumed to produce an interaction energy $V(\rho)$ dependent only on the total baryon density, independent of the degree of pion condensation, and also to produce a constant G-matrix element g' in the nucleon-nucleon charge exchange channel. In the absence of condensation the equation of state reduces to that of interacting normal matter. Also the effects of beta equilibrium and form factors in the p-wave pion-nucleon interaction are considered. The condensed models are stable. Depending on the choice of parameters the models exhibit first- or second-order pion condensation phase transitions, or both. (auth)

27730 MULTI-STEP PROCESSES IN HIGH-ENERGY ELASTIC AND INELASTIC NUCLEAR SCATTERING. Kujawski, E. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Physics). Nucl. Phys., A; 236: No. 2, 423-444(30 Dec 1974).

Multi-step processes in elastic and inelastic nuclear scattering at intermediate and high energies are investigated using a formulation whereby a finite number of channels are explicitly treated, while all the other channels are approximately accounted for through a "second-order potential matrix." Within the framework of the eikonal approximation the problem reduces to a finite system of first-order coupled integro-differential equations with nonlocal potentials which depend on the two-body density matrix of the target nucleus. The relationship of the above formulation to the DWIA, the close-coupling method, and the Glauber multiple scattering model is examined. This approach is applied to the elastic and inelastic (2^+, 4.43 MeV) scattering of 1-GeV nucleons by ^{12}C. The corrections to the DWIA are sizeable, and the inelastic scattering appears to be very sensitive to the multi-step contributions and the nuclear structure. (auth)

27731 SUPERMULTIPLET EXPANSION FOR NUCLEAR REACTIONS. John, G. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik); Seligman, T. H. (Koeln Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 236: No. 2, 397-404(30 Dec 1974).

Asymptotic wave functions for nuclear reactions with two fragments are expanded into supermultiplets. The expansion coefficients turn out to be essentially coefficients of fractional parentage for the spin-isospin part. (auth)

27732 POLARIZATION TRANSFER IN DEUTERON STRIPPING REACTIONS. Santos, F. D. (Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares). Nucl. Phys., A; 236: No. 1, 90-124(23 Dec 1974).

Polarization phenomena involving the spins of a and b in the A(a,b)B reaction are discussed using a complete set of irreducible tensors carrying definite spin transfer. The linear model independent equations relating the cross section and the polarization observables with these tensors are shown to be particularly appropriate for the study of spin-dependent interactions, preferentially associated with particular values of spin transfer. The DWBA theory of polarization transfer in deuteron stripping reactions is thoroughly discussed, and among the 17 polarization observables we distinguish those likely to be more sensitive to spin-dependent distortion, to have stronger deuteron D-state effects, to exhibit the sign-rule j-dependence and other forms of j-dependence. For certain deuteron polarizations, when the spin transfer is pure $s = \frac{1}{2}$, it is shown that deuteron stripping reactions are transparent to vector polarization transfer and the outgoing nucleon polarization is independent of scattering angle and deuteron energy. DWBA calculations including contributions from spin transfer $\frac{3}{2}$ through the deuteron D-state and spin–orbit distortion show that polarization transfer in such deuteron polarizations can be explored as a method of producing fast polarized neutrons with known polarization. (auth)

27733 EXACT FIRST-ORDER RECOIL FOR S-WAVE SINGLE-NUCLEON TRANSFER REACTIONS. Hauge, P. S. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Nucl. Phys., A; 236: No. 1, 61-66(23 Dec 1974).

A simple formalism is developed for treating first-order recoil exactly in single-nucleon transfer reactions. The recoil terms are converted, by means of gradient identities and Green's theorem, to forms similar to that of the "no-recoil" expression. (auth)

27734 EXACT TREATMENT OF THE DWBA BY ANALYTIC MEANS FOR PARTICLE TRANSFER BETWEEN HEAVY IONS. Glendenning, N. K.; Nagarajan, M. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., A; 236: No. 1, 13-28(23 Dec 1974).

The Fourier–Bessel expansion is utilized for the exact evaluation of the DWBA amplitude in transfer reactions. The partial-wave radial components of the elastic scattering wave function in the outgoing channel and one of the bound-state wave functions of the transferred particle are expanded in terms of a complete set of spherical Bessel functions over a finite interval. For a radial wave function of a given angular momentum, the basis is chosen to be a complete set of spherical Bessel functions of the same angular momentum, so that the addition theorem for the product of spherical Bessel function and spherical harmonic can be utilized. It is shown that the method proposed has the distinct advantage that the recoil angular momentum appears as a natural expansion parameter, and that the various approximate methods can be retrieved as simple limits of the exact expression. The method is applied to the transfer of a single nucleon or a cluster, and to the transfer of several nucleons. (auth)

27735 PION CHARGE-EXCHANGE REACTIONS WITH NUCLEI. Miller, G. A.; Spencer, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Phys. Lett., B; 53: No. 4, 329-332(23 Dec 1974).

Elastic pion charge-exchange reactions are examined within the framework of a coupled-channel optical model. Several new effects are studied for their influence on charge-exchange reactions. The most interesting result is the predicted dominance of two-nucleon short-range correlations near 100 MeV. (auth)

27736 DEEP INELASTIC COLLISIONS BETWEEN HEAVY IONS. Broglia, R. A.; Dasso, C. H.; Winther, Aa. (Niels Bohr Institutet, Copenhagen (Denmark)). Phys. Lett., B; 53: No. 4, 301-305(23 Dec 1974).

The semiclassical coupled equations for heavy ion reactions are utilized to describe deep inelastic collisions and fusion. The loss of energy and angular momentum from the relative motion and the transfer of mass and charge are included in the calculation of the classical trajectories. Through a detailed model calculation it is shown that compound formation is automatically included in this description. (auth)

27737 STATISTICAL MODELS OF FRAGMENTATION PROCESSES. Goldhaber, A. S. (State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics). Phys. Lett., B; 53: No. 4, 306-308(23 Dec 1974).

A model with minimal correlations among nucleon momenta agrees well with refined data on fragment momentum distributions resulting from peripheral nucleus–nucleus collisions. The postulates are identical to those of Feshbach and Huang, but are applied to compute a quantity more relevant to experiment: the dependence of the momentum distribution on fragment mass. (auth)

27738 CLUSTER STRUCTURES IN DOUBLE-HUMPED FISSION BARRIERS. Schultheis, H.; Schultheis, R.; Wildermuth, K. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 53: No. 4, 325-328(23 Dec 1974).

A method is proposed to calculate the shell energy in fission using cluster representations. First results show that the ground state and the second minimum are due to the formation of doubly-magic clusters, while the barriers are due to their breakup. (auth)

27739 SPURIOUS CENTER-OF-MASS MOTION. Gloeckner, D. H.; Lawson, R. D. (Argonne National Lab., Ill. (USA)). Phys. Lett., B; 53: No. 4, 313-318(23 Dec 1974).

A simple numerical procedure is given for the removal of states with spurious center-of-mass components. The method does not require explicit construction of the spurious states. It is shown that removal of spurious components significantly modifies the ^{16}O spectrum of Zuker, Buck and McGrory. (auth)

27740 SMOOTHING METHODS IN THE INDEPENDENT PARTICLE MODEL. Jennings, B. K.; Bhaduri, R. K. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics). Nucl. Phys., A; 237: No. 1, 149-156(6 Jan 1975).

For Strutinsky calculations in finite wells, it is necessary to generate an artificial set of unbound states to obtain the smoothed energy. The results of such a procedure are checked in a simple model finite potential by calculating the smoothed energy with a semi-classical method that makes no reference to the unbound states and has no free parameters. It is found that the agreement between the two methods is excellent. Considering the smoothing of spatial density in a simple case, it is shown that inclusion of corrections of order $\hbar^2$ to the Thomas–Fermi density makes it nearly identical to the Strutinsky-smoothed spatial density. (auth)

27741 A SOLUBLE MODEL FOR THE MONOPOLE VIBRATION. Blaizot, J. P.; Grammaticos, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service de Physique Theorique). Phys. Lett., B; 53: No. 3, 231-233(9 Dec 1974).

By assuming the Hartree–Fock field to be an harmonic oscillator, a soluble collective Schrödinger equation is derived for the monopole mode. The validity of the model is established by considering a more realistic case. (auth)

27742 DESCRIPTION OF THE POLARIZATION IN NUCLEAR REACTIONS. Hategan, C. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 9, 947-963(1974). (In Rumanian).

A description of the polarization phenomena, based on the Madison convention is presented. The polarization of the nucleon, deuteron and photon is treated in detail. (auth)

27743 NON-EQUILIBRIUM NUCLEAR ABUNDANCES IN SUPERDENSE MATTER. Koebke, K.; El Eid, M. F.; Hilf, E. R. (Technische Univ. Darmstadt (F. R. Germany). Inst. fuer Kernphysik). Z. Phys.; 271: No. 1, 21-30(Nov 1974).

4 figs.; 4 tabs.; 10 refs.

The equation of state and nuclear composition are calculated for cold matter below neutron-drip density (approximately 4×10^{11} g/cm^3) using recent nuclear data. Nuclear transmutations of hot and dense matter taking care of the freezing of nuclear reactions are discussed for three types of temperature and density changes. (auth)

27744 ANGULAR MOMENTUM PROJECTED HARTREE–FOCK THEORY. P. 2. Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); Hernandez, E. J. (Buenos Aires Univ. Nacional (Argentina). Departamento de Fisica); Plastino, A. (La Plata Univ. Nacional (Argentina). Departamento de Fisica). Z. Phys.; 271: No. 1, 7-9(Nov 1974).

5 refs.

The Euler–Lagrange equations corresponding to the Hartree–Fock variational problem after angular momentum projection are derived, including one particle–one hole corrections. The solutions are seen to pose a numerical problem only slightly more complicated than the ordinary HF one. (auth)

27745 SUCCESSIVE TRANSFER REACTIONS. Robson, D. (Florida State Univ., Tallahassee). Comments Nucl. Particle Phys.; 6: No. 1, 3-7(Feb 1974).

It is stated that in studies of nuclear reactions involving multi-nucleon transfer difficulties have arisen in describing such well known reactions as the two-neutron pick-up (p,t) reaction. An understanding of such reactions is important if they are to be used to investigate pairing correlations in nuclei in a reliable manner. Current theories of successive transfer are discussed, together with other relevant considerations. 6 references. (UK)

27746 SIMPLE SEPARABLE EXPANSIONS FOR CALCULATING MATRIX ELEMENTS OF TWO-BODY LOCAL INTERACTIONS WITH HARMONIC OSCILLATOR FUNCTIONS. Gogny,

D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Nucl. Phys., A; 237: No. 3, 399-418(20 Jan 1975).

A simple method is proposed to calculate the matrix elements of two-body local interactions using a harmonic oscillator basis (HOF). By using the properties of HOF, it is shown that any local potential can be replaced by a simple series for the purpose of calculating matrix elements. This series can be reduced to a finite sum when evaluating a matrix element. Its terms are separable functions of the coordinates of the two particles, hence the advantage of the method. The most important components of the two-body interaction, namely central, two-body spin–orbit, and tensor forces, are treated. As a representation, spherical harmonic oscillator functions expressed with spherical coordinates have been chosen. This technique appears to be very well adapted to and efficient for Hartree–Fock calculations in any representation of the HOF. A very interesting feature of this formulation is that it can be easily extended to calculations employing generalized HOF as defined by Wong. (auth)

27747 A MODEL NEUTRON SOLID WITH π^0 CONDENSATE. Pandharipande, V. R.; Smith, R. A. (Illinois Univ., Urbana (USA). Dept. of Physics). Nucl. Phys., A; 237: No. 3, 507-532 (20 Jan 1975).

The energy of solid neutron matter configurations in which layers of parallel spin neutrons with spin direction perpendicular to the plane of the layer are stacked such that neutrons in adjacent layers have antiparallel spins is investigated. This configuration has a π^0 condensate with wavelength of twice the interlayer distance and has the lowest tensor potential energy. The one-pion exchange tensor force is found to be too weak to stabilize the solid. The π^0 condensate, however, excites the neutrons to Δ^0 (3,3 resonance) states. These excitations can enhance the effective tensor force strength by factors of 3–4. Model calculations which include the $N \rightarrow \Delta^0$ excitations predict a solid phase whose energy becomes lower than that of the liquid at about twice nuclear matter density. The possible effects of this phase transition on neutron star structure are discussed. (auth)

27748 PHENOMENOLOGY OF PIONIC NUCLEON CAPTURE. Reitan, A. (British Columbia Univ., Vancouver (Canada). Dept. of Physics). Nucl. Phys., A; 237: No. 3, 465-476(20 Jan 1975).

The reaction A(p,π)B is described by a method similar to that employed in the Butler theory for nuclear stripping and pick-up reactions. A comparison has been made with experiments at 185 MeV. (auth)

27749 A HEURISTIC MODEL OF PION-NUCLEUS CHARGE-EXCHANGE SCATTERING. Tow, D.; Eisenberg, J. M. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Nucl. Phys., A; 237: No. 3, 441-446(20 Jan 1975).

The (π^+,π^0) reaction on nuclei is treated in distorted-wave impulse approximation by using eikonal wave functions for the pion. Results for the total cross section for excitation of the isobaric analog resonance exhibit a minimum near the 3,3 resonance, especially for larger nuclei, due to the strong pion absorption there. (auth)

27750 ON THE CRITICAL DISTANCE IN FUSION REACTIONS. Glas, D.; Mosel, U. (Giessen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 237: No. 3, 429-440(20 Jan 1975).

A new expression for the fusion cross section is derived that reconciles results obtained on critical fusion distances by different experimental groups. It is shown that low-energy data are sensitive to the interaction barrier, whereas high-energy fusion data sample the interaction potential at much smaller distances. Extensive comparisons of this model with experimental data are given. The need for data over a large energy range is stressed. (auth)

27751 MOMENTUM TRANSFER SUM RULES IN ELECTRON SCATTERING. O'Connell, J. S.; Lightbody, J. W. Jr. (National Bureau of Standards, Washington, D. C. (USA)). Nucl. Phys., A; 237: No. 2, 309-318(13 Jan 1975).

The integral properties of elastic and inelastic Coulomb form factors are examined. Relations are given for the nuclear Coulomb energy, central charge density, transition charge, radial moments, and squared density integral. (auth)

27752 ELASTIC SCATTERING OF HEAVY IONS: THE SIMPLEST INTERPRETATION? Kirzon, Z.; Dar, A. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). Nucl. Phys., A; 237: No. 2, 319-332(13 Jan 1975).

Elastic scattering of heavy ions with incident energies well above the Coulomb barrier is predicted from a simple extension of the Glauber theory for high energy particle–nucleus scattering. The only parameters needed are the "measured" nuclear density distribution function and the measured forward amplitude for free nucleon–nucleon scattering. An extensive comparison between theory and experiment is presented. It is demonstrated that the nuclear absorption needed to reproduce the measured differential cross section for elastic scattering can be well reproduced by means of the measured free nucleon–nucleon total cross section and the nuclear density distribution as "measured," for instance, by electron scattering. Remarkable agreement between theory and experiment is demonstrated. (auth)

27753 ASPECTS OF TWO-NUCLEON TRANSFER REACTIONS. Iano, P. J.; Pinkston, W. T. (Vanderbilt Univ., Nashville, Tenn. (USA)). Nucl. Phys., A; 237: No. 2, 189-214(13 Jan 1975).

Two-nucleon transfer reactions are studied with special emphasis on the form factors. Zero-range approximation is assumed. Form factors are calculated for the reaction, ^{40}Ca(t,p)^{42}Ca ground state. The nucleus ^{42}Ca is taken to consist of two neutrons plus the ^{40}Ca closed shell. Wave functions are determined from multiconfiguration shell-model calculations. Harmonic oscillator single-particle functions are used as a basis, and the core–particle interaction is taken to be a Woods–Saxon potential. Results are presented for calculations including as many as 50 configurations. These results are generally in agreement with the calculations of Ibarra and Bayman, except that no evidence is found for the "extra node" in the radial form factor just beyond the nuclear surface. The asymptotic properties of two-nucleon form factors are discussed, and a critique is given of previous approaches, including the recent work of Ibarra. Zero-range DWBA is reformulated in such a way that the effect on the cross section of the assumed form of the interparticle potential can be studied. This also results in a cross section free of arbitrary normalization constants. The cross-section shapes were found to be insensitive to the form of the interaction, and the absolute cross section predicted was found to be much too small by a factor of 15. (auth)

27754 A NUMERICAL STUDY OF RESONANCE CONTRIBUTIONS TO NUCLEAR SUM RULES. Romo, W. J. (Carleton Univ., Ottawa, Ontario (Canada). Dept. of Physics). Nucl. Phys., A; 237: No. 2, 275-284(13 Jan 1975).

The modified form of the nuclear sum rule which was proposed by Berggren is applied to a simple solvable problem; and it is demonstrated, within the confines of that problem, that the continuum contribution to the sum rule is often dominated by the contribution from a few resonances, just as Berggren had anticipated. It is further shown that the bound, virtual and resonant states of the Hamiltonian considered form a complete set of states in terms of which the internal region of space can be expanded. (auth)

27755 CONDENSATION IN NEUTRON STARS. Markin, O.A.; Mishustin, I.N. (I. V. Kurchatov Institute of Atomic Energy). JETP Lett. 20: No. 7, 226-228 (5 Oct 1974).

We investigate the change introduced by π condensation in the equation of state of neutron matter. (auth)

27756 IS NUCLEAR MATTER VISCOUS? Recherche (Paris); 5: No. 47, 668-671(Jul 1974). (In French).

Nuclear viscosity was shown by the use of heavy ions as projectiles for the study of nuclear matter. The partial fusion caused by tangential collisions takes place with a large exchange of kinetic energy and nuclear matter, as though a neck of nuclear matter were formed in the same way as between two drops of oil, by viscosity. A second type of phenomenon connected with nuclear viscosity was also observed: when a fusion center is created, it shows a strong tendency to fission. Finally, the appearance of functional and viscosity forces during the approach of nuclei prevents fusion in the case of certain heavy projectiles such as krypton. (FR)

27757 EFFECT OF THE SHELL STRUCTURE ON THE MOMENT OF INERTIA. The Behavior of the Averaged Moment of Inertia. Pashkevich, V. V.; Frauendorf, S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 6, 1122-1130(Dec 1974). (In Russian).

In order to investigate the effect of the shell structure on the moment of inertia, expressions for the averaged moment of inertia and the shell contribution are proposed. The numerical calculations show that the plateau condition, which justifies the proposed partition, is fulfilled. Both types of the moment of inertia are calculated as a function of the particle number and the deformation, and are compared with the rigid-body value and with the value for the heated nucleus. The order of magnitude of the shell effects at the equilibrium deformation is investigated, and some situations in which these effects are expected to be large are suggested. (5 figures) (auth)

27758 APPROXIMATE METHOD IN THE INVERSE PROBLEM OF NUCLEAR THEORY. Zakhar'ev, B. N.; Niyazgulov,

S. A.; Suz'ko, A. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 6, 1273-1281(Dec 1964). (In Russian).

In the framework of finite-range forces and the finite-difference approximation for the Schrödinger equation the ⟨⟨exact⟩⟩ inverse problem is formulated: the recovered potential gives without distortions the initial scattering parameters when solving the direct problem. The method is generalized to the case of complex potentials, of potentials with a known long-range component, as well as to the case of equations describing multichannel processes. It is noted that the inverse problem can be used to study many-body systems. (auth)

27759 SPIN DEPENDENCE OF THE NUCLEAR FORCES. Ionescu-Pallas, N. (Inst. of Atomic Physics, Bucharest). Stud. Univ. Babes-Bolyai, Ser. Phys.; 19: No. 2, 77-83(1974). (In Rumanian).

The explicit expression of the nuclear two body potential energy operator, in terms of the spin invariants, is obtained under the most general assumptions, resorting solely to the intrinsic and reciprocal properties of the mentioned invariants and to some analytic properties of the potential function. (auth)

27760 DIFFRACTIVE BREAK-UP OF DEUTERONS ON NUCLEI WITH A DIFFUSE EDGE. Sitenko, A. G.; Polozov, A. D.; Evlanov, M. V. (Inst. of Theoretical Physics, Moscow). Yadern. Fiz.; 20: No. 6, 1155-1161(Dec 1974). (In Russian).

Cross sections for various diffractive processes in interactions of high-energy deuterons with nuclei are calculated as a function of the diffuseness of the nuclear edge. It is shown that, due to the diffuseness of the nuclear edge, the mass number dependence of the cross section of deuteron diffractive break-up is not monotone. (2 figures, 1 table) (auth)

27761 NEW THEOREMS FOR COMBINATION OF ROTATIONS. Varshalovich, D. A.; Moskalev, A. N.; Khersonskii, V. K. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1727-1732(Aug 1974). (In Russian).

Theorems for the combination of Wigner D functions $D^{l}_{mm'}(R)$ were obtained for the spherical harmonic $C_{lm}(\vec{n})$, for the character of the $\chi^{l}(R)$ representation, and the generalized character $\chi^{l}_{\Lambda}(R)$ in the case of three and four rotations. These relations make it possible to achieve a transformation from the angular variables, corresponding to a given frame of reference, to relative angles and rotations. (2 figures) (tr-auth)

27762 REPRESENTATION OF ROTATION GROUPS IN THE VARIABLES ω, $n(\Theta,\phi)$. Varshalovich, D. A.; Moskalev, A. N.; Khersonskii, V. K. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1711-1726(Aug 1974). (In Russian).

In the description of angular and polarization correlations of particles in nuclear reactions and decay, it was shown to be expedient to use the finite rotation matrix $U^{l}_{MM'}(\omega,n)$ in the variable rotation angle ω and rotation axis $n(\Theta,\phi)$ in place of the matrix $D^{l}_{MM'}(\alpha,\beta,\gamma)$, dependent on three Euler angles. The properties of the finite rotation matrix were examined in the JM representation. The explicit form of these functions, the differential equation, recurrence relations, and the theorem for combinations of rotations were given. The matrix was expanded in spherical functions $C_{\lambda\mu}(n)$. The properties of the coefficients of this expansion are discussed. Tables of functions are given. (1 figure, 4 tables) (tr-auth)

27763 MOLDAUER'S THEORY OF STATISTICAL MODEL. Vladuca, G. (Univ., Bucharest). Stud. Cercet. Fiz.; 26: No. 7, 775-777(1974). (In Rumanian).

The main corrections brought by Moldauer to the traditional statistical Hauser–Feshbach model are analyzed by taking into consideration the spacing and width distribution laws which are supposed to be known. (auth)

27764 SOLUTION OF EQUATIONS FOR THE MONOPOLE AND QUADRUPOLE OSCILLATIONS WITH CONSIDERATION OF ANHARMONIC TERMS. Steshenko, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1648-1652(Aug 1974). (In Russian).

The solutions of these equations with consideration of anharmonicity of both kinematic and dynamic nature are examined. In the equations of the principal approximations of the generalized hyperspherical function method, the collective coordinates (a,b,c) were transposed to the variable generalized model (β,γ,φ). Writing the equations in this manner made it possible in the framework of the principal approximation to examine the monopole and quadrupole oscillations of magic nuclei. (2 figures, 1 table) (JSR)

27765 APPROACH TO A UNIFIED DESCRIPTION OF EXCITED STATES OF ATOMIC NUCLEI. Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1580-1587(Aug 1974). (In Russian).

The Hamiltonian describing the interactions between nucleons in the nucleus is analyzed term by term to determine which members exist during intermediate and high excitation energies, which are responsible for the complication of the structure of the states with increase of excitation energy, and what are the characteristics of the wave functions of highly excited states in comparison with the wave functions of low-excited states. The average field of spherical and deformed nuclei, pairing correlations, multipole–multipole and spin-multipole–spin-multipole interactions, density of excited states, complication of structure with increasing excitation energy, and the structure of highly excited states and compound states are examined. (1 figure) (JSR)

27766 ACCURACY OF THEORETICAL CALCULATIONS OF THE COEFFICIENTS OF INTERNAL CONVERSION OF γ LINES. Listengarten, M. A.; Band, I. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1588-1599(Aug 1974). (In Russian).

A review is presented of the development of theoretical calculations of the internal conversion coefficients of γ lines. The original attempts to tabulate these coefficients and the inherent errors in the earlier tables are discussed. Inaccuracies of a physical origin in theoretical coefficients which can be taken into consideration in accurate calculations were examined. Anomalies in the coefficients which are not yet amenable to comprehensive calculations are discussed. (5 tables) (JSR)

27767 EFFECT OF TOTAL SPIN–SPIN INTERACTION BETWEEN NUCLEONS ON THE THEORY OF NUCLEAR MATTER. Dzhavadov, A. V.; Tveretskii, A. P. (Azerbaydzhan State Univ., Baku). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1772-1777 (Aug 1974). (In Russian).

The effect of the total spin–spin interaction between nucleons on the theory of nuclear matter was studied. The investigation was made on the basis of a hard-core potential with the components dependent on the spins of the nucleons. (tr-auth)

27768 CRITICAL DISTANCE IN HEAVY ION COLLISIONS. Marinov, M. S.; Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 2, 421-431(Feb 1975). (In Russian).

A variational calculation is carried out for the critical distance R_{cr} between colliding ions. Values of R_{cr} are calculated in the $90 \leq Z \leq 100$ region with allowance for finite size of the nuclei. In this case R_{cr} greatly exceeds the nuclear radius r_N (for example $R_{cr} \approx 50$ F for uranium nuclei). The results can be employed for checking the predictions regarding the cross section for spontaneous, positron production in Coulomb collisions of heavy nuclei. (auth)

27769 INVERSE PROBLEM OF SCATTERING THEORY IN COMPLEX λ PLANE IN THE PRESENCE OF A COULOMB FIELD WITH ALLOWANCE FOR ABSORPTION. Malyarov, V. V.; Poplavskii, I. V.; Popushoi, M. N. (Odessa Construction-Engineering Inst.). Zh. Eksp. Teor. Fiz.; 68: No. 2, 432-436(Feb 1975). (In Russian).

An algebraic approach to the solution of the inverse problem of scattering theory for charged particles in the plane of a complex orbital angular momentum l for a fixed physical value of the energy is examined. Formulas are obtained for the nuclear interaction potential in which absorption is taken into account and the "nuclear" phase shift $\delta(\lambda,k)$ is assumed to be of the form as was found previously. (auth)

27770 MULTICHANNEL PHENOMENA IN NUCLEAR REACTIONS AT LOW ENERGIES. Hategan, C. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 7, 725-753 (1974). (In Rumanian).

The discussion covers the (d,p) reaction anomaly at the threshold of the (d,n) analogous channel, threshold phenomena, channel coupling phenomena, and the numerical analysis of the (d,p) reaction anomaly at the threshold of the analogous channel. (auth)

27771 RECENT DEVELOPMENT IN THE STUDY OF THE RADIATIVE CAPTURE OF NEUTRONS IN THE REGION OF GIANT DIPOLE RESONANCE. Budnar, M.; Cvelbar, F.; Likar, A.; Potokar, M. (Univ. of Ljubljana, Yugoslavia). Fizika, Suppl. (Zagreb); 6: 11-12(1974).

From proceedings of Yugoslav nuclear physicists meeting; Zlatibor, Yugoslavia (29 May 1973).

A summary is given of previous work on neutron radiative capture. Then the semidirect capture model is refined to calculate the angular distribution of capture gamma rays. (JFP)

27772 INVERSE PROBLEM OF THE SCATTERING OF NUCLEONS BY ATOMIC NUCLEI AT ONE ENERGY. Terentakii, K. O. (Kiev State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1698-1702(Aug 1974). (In Russian).

A practical method based on the reduction of the potentials according to the asymptotic values of the scattering phase is pro-

posed for the inverse scattering problem. A numerical evaluation was made of the procedure, and the results obtained were quite good for ^{12}C at $E_p > 50$ MeV. (2 figures, 1 table) (JSR)

27773 CONTEMPORARY STATUS OF THE SHELL MODEL. Smirnov, Yu. F. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1627-1638(Aug 1974). (In Russian).

A review is presented of the contemporary status of the nuclear shell model. The shell model and the translational-invariant shell model, variational calculations based on the translational-invariant model, different coupling schemes in the translational-invariant model and its relation with K-harmonics methods, the cluster model, and the generator-coordinate method and nuclear reactions are examined. (JSR)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 25276, 25846, 25848, 26069, 26070, 26091, 26094, 26098, 26099, 26197, 26611–26613, 26915, 27216, and 27621.

27774 (AED-CONF-74-509-012) DEPTH DOSE DISTRIBUTION MEASUREMENTS AND ATTENUATION FOR A ^{252}Cf SOURCE. Piesch, E.; Sayed, A. M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). 1974. 17p. INIS.

From second symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

10 figs.; 11 refs. With abstract.

In the radiation field of a ^{252}Cf source the neutron depth dose distribution was measured in a water phantom by means of neutron threshold detectors. Two exposure positions were used: normally and isotropically incident neutron fluence with the source positioned on the surface and inside the phantom. The thin detectors used for these experiments were ^{237}Np and ^{232}Th fission fragment track etching detectors and a Makrofol recoil track detector with threshold energies of 0.75 MeV, 1.2 MeV and 1 MeV, respectively. An experimentally found calibration factor for fission neutrons has been used. The fluence distribution as a function of source distance found free in air and in the phantom are discussed and compared with calculated and experimental results from other authors. From the depth dose distribution of a needle and point ^{252}Cf source the attenuation in tissue and the corresponding relaxation length were evaluated. (auth)

27775 (BARC-758) FAST NEUTRON POINT SOURCE DOSE KERNELS. Nagarajan, P. S.; Raghavendran, C. P. (Bhabha Atomic Research Centre, Bombay (India)). 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

In connection with the study of the dosimetry of Cf-252 spontaneous fission neutron sources, fast neutron dose kernels for mono-energetic point sources in a HCNO medium of standard man composition, have been computed. These have been obtained using a basic Monte Carlo method employing cross section data in 86 groups. In the calculations neutron scatterings were assumed to be isotropic in the centre of mass system. Ten thousand source histories from a point source of neutrons situated at the centre of a sphere of standard man composition were considered for each of the source energies in the range, 0.3 MeV to 14 MeV. The $N^{14}(n,p)C^{14}$ component and the $H(n,\gamma)D$ component are included in the dose kernels. The method of computing these two components are given in the appendix. The input for these computations is the thermal neutron source distributions obtained for the various source energies, by the Monte Carlo methods. The overall accuracy of the absolute value of the dose at any point is better than ±10 percent. The dose kernels are presented. As an application of these results the point source dose kernels for a spontaneous fission neutron source of Cf-252 has been computed and is shown. No correction was made for the gamma attenuation in the sheathing material. Results for spheres of radii 20 cm and 10 cm are given to show the insignificance of the effect due to the size of the sphere. Also shown is the first collision kernel for comparison. (MHR)

27776 (HEDL-TME-73-89) PUSHLD: A CODE FOR CALCULATION OF GAMMA DOSE RATES FROM PLUTONIUM IN VARIOUS GEOMETRIES. Strode, J. N.; Van Tuyl, H. H. (Hanford Engineering Development Lab., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-2170. 85p. AT.

The computer program PUSHLD, which is written in Fortran V, calculates dose rates due to gamma radiation from a variety of three dimensional plutonium source and shield geometries at various distances. Although the program is capable of calculating sources with point, line, disk, sphere, cylinder and slab geometries, it is found in actual practice that the cylindrical and spherical calculations adequately represent the plutonium sources usually encountered in nuclear fuel manufacture. The shield geometry capabilities include slab, cylindrical and spherical. The other variables included in the calculations are: (1) source composition, including both isotopic composition and chemical composition (e.g., the source calculation may be on a plutonium metal source, plutonium dioxide, uranium-plutonium mixed oxide, etc.); (2) source to dose point distance with good accuracy obtained at distances from 0.1 mm to about 2 meters; (3) source density; (4) time after the plutonium separation and purification which compensates for the effect of daughter decay products; (5) shield materials including most of those materials used as gamma shields and in construction of glove boxes used in fuel manufacture; and (6) shield thickness. With respect to the isotopic composition of the source, all of the isotopes of plutonium including ^{236}Pu and of uranium can be included in the source definition and also any ^{241}Am and ^{237}U impurities analytically detected. The computer output is normally given in R/hr at a specified distance from the source and time after pollution purification through a variety of shield conditions for a specified source and shield geometry. PUSHLD calculated gamma dose rates were found to agree with measured results to within ±20% for most plutonium isotopic compositions and shield materials. PUSHLD calculations are based on the point kernel method and include the effects of self shielding and radiation due to external shielding. Secondary radiations are included for Compton scattering, x-rays from photo-electric absorption and electrons from photo-electric absorption. The numerical values of Compton buildup factors below 0.5 MeV which are used by the code were derived from a modified straight-ahead approximation since values available from the literature resulted in significant overestimation of dose rates. Provision is made in the program for including buildup from self-shielding, and for estimating the effective buildup factor from composite shields. (auth)

27777 (IPNO-CF-74-01) RADIATION DAMAGE AND HYPERFINE INTERACTIONS. Bernas, H. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). 1974. 52p. (CONF-740633-5). Dep. NTIS (US Sales Only) $5.75.

From international conference on hyperfine interactions studied in nuclear reactions and decay; Uppsala, Sweden (10 Jun 1974).

A partial-summary of the Dieppe Meeting on Radiation Damages and Hyperfines Interactions (HFI) is presented. The emphasis is put on the relation between recent HFI experiments and information obtained in the fields of heavy ion stopping theory and classical radiation damage annealing studies. Damage cascade evolution, annealing behavior, dose effects and impurity evolution are discussed successively. (FR)

27778 CHARGE STATE RATIOS FOR HELIUM IONS CHANNELLED THROUGH SILICON. Petty, R. J.; Dearnaley, G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Phys. Lett., A; 50: No. 4, 273-274(11 Dec 1974).

The ratio $^4He^{++}/^4He^+$ is measured for helium ions emerging from channelled and random directions in silicon for the energy range 0.4–1.2 MeV. The ratio is observed to be higher for the ⟨110⟩ channel direction than for the ⟨111⟩ channel or random directions. (auth)

27779 GAMMA-RAY AND ELECTRON TRANSPORT BY MONTE CARLO. Thompson, W. L. Charlottesville, VA; Univ. of Virginia (1974). 527p. University Microfilms Order No. 75-4667.

Thesis (Ph. D.).

A Monte Carlo computer code, MONTELEC, has been developed which simulates the coupled transport of gamma rays and electrons with associated bremsstrahlung effects. Results of the code indicate a significant contribution to transmitted dose and albedo from bremsstrahlung for the combination of high-energy incident gamma rays and high atomic number shields. The computational results corroborate the results of a series of experiments performed at the University of Virginia. In the case of transmission, the dose rate measured in the experiments and calculated by MONTELEC for 8-MeV gamma rays incident on 12.95 cm of lead significantly exceeds results of standard calculational techniques, such as the moments method or conventional Monte Carlo without bremsstrahlung. In the albedo experiments and Monte Carlo calculations, a significant number of backscattered photons (accounting for about 60% of dose albedo) were observed having energies above 0.51 MeV, which would not have been predicted by the standard calculations. This dissertation represents the first study of the importance of secondary radiation in high-energy gamma-ray shielding by a Monte Carlo code that very closely approximates the physical situation without the use of simplifying assumptions. Data are presented regarding the production and transport of secondary electrons from primary photons in cases in which these effects are significant in the gamma-ray transport problem. (Diss. Abstr. Int., B)

27780 DIFFERENTIAL CHARACTERISTICS OF THE ENERGY ALBEDO OF γ QUANTA FOR FINITE MEDIUM. Viktorov, A. A.; Mashkovich, V. P. Vop. Fiz. Zashch. Reaktorov; No. 6, 116-120 (1974). (In Russian).

The dependence of the differential characteristics of the energy albedo of γ quanta from flat monodirectional sources on the thickness of homogeneous barriers and on the radius of finite media in the form of cylinders of infinite length was examined experimentally and theoretically for water, aluminum, iron, and lead for γ quanta in the energy range from 0.412 to 2.75 MeV. The depen-

dence of the differential albedo on the transverse dimensions of the reflector was also determined. (JSR)

27781 INVESTIGATION OF THE FIELD OF SCATTERED RADIATION AT LARGE DISTANCES FROM THE SOURCE. Zolotukhin, V. G.; Ksenofontov, A. I.; Panchenko, A. M.; Sinev, V. N. Vop. Fiz. Zashch. Reaktorov; No. 6, 72-78(1974). (In Russian).

A non-analog method is proposed for the simulation of radiation transport processes. It uses both the displacement geometric part of the kernel of the Boltzmann equation (dispersion minimization method) and the displacement of the scattering nucleus. Displacement according to polar angles was used which leads to a finite dispersion of the local evaluation of the flux and to an evaluation of the statistical errors of the unknown functionals. With this method calculations can be made of the differential characteristics of the scattered radiation at large distances from the source for multidimensional problems with simultaneous evaluation of the statistical errors of the results obtained. (JSR)

27782 USE OF THE PERTURBATION THEORY FOR PROBLEMS ON THE SCATTERING OF γ RADIATION. Petrov, E. E.; Shemetenko, B. P. Vop. Fiz. Zashch. Reaktorov; No. 6, 43-59 (1974). (In Russian).

The basic formulas of the perturbation theory and the analytical representation of the basic and accompanying functions are given. A formula is derived from these basic formulas and analytical representations for the calculation of the effect of scattered radiation. A comparison of theoretical calculations made on the basis of the formula derived with experimental data showed that the formula is valid for source–detector–scatterer distances greater than 10 m. (JSR)

27783 STOPPING POWER OF HAVAR FOR 0.8–3.9 MeV DEUTERONS AND 2.9–6.0 MeV PROTONS. Duder, J. C.; Clare, J. F.; Naylor, H. (Auckland Univ. (New Zealand). Dept. of Physics). Nucl. Instrum. Methods; 123: No. 1, 89-91(1 Jan 1975).

Stopping powers of 0.8–3.9 MeV deuterons and 2.9–6.0 MeV protons have been measured for Havar foil. An Enge spectrograph was used in the energy loss measurements. Results are consistent with the additivity of stopping effects of the constituent elements of the alloy, a conclusion which differs from that of Porter et al. (Nucl. Instr. and Methods 89 (1970) 237). (auth)

27784 STOPPING POWERS OF He, AIR, AND Kr FOR 5 TO 110 MeV URANIUM IONS. Betz, G.; Isele, H. J.; Roessle, E. (Freiburg Univ. (F.R. Germany). Fakultaet fuer Physik); Hortig, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Instrum. Methods; 123: No. 1, 83-87(1 Jan 1975).

Range–energy curves for 5–110 MeV uranium ions in He, air, and Kr have been measured and stopping powers, $\Delta E/\Delta X$, evaluated by differentiation. After corrections for nuclear stopping and range straggling the resulting electronic stopping powers are compared using the Bethe formalism. (auth)

27785 A NUMERICAL METHOD FOR SOLVING THE RADIATIVE TRANSFER EQUATION IN TWO-DIMENSIONAL X–Y GEOMETRY. Ellison, D.; Grant, I. P. (Oxford Univ. (UK)). Comput. Phys. Commun.; 8: No. 4, 257-269(Nov 1974).

A method of solving the radiative transfer equations in two-dimensional X–Y geometry is proposed. By starting from the interaction principle, a set of linear equations for the intensities on a discrete grid in a rectangular domain are derived, by an extension of the one-dimensional method of Grant and Hunt. The method yields positive intensities and flux conservation, provided that the size of the cells of the grid is sufficiently small. A simple problem is presented to illustrate the method. (auth)

27786 COMPENSATION METHOD FOR PROCESSING THE γ RADIATION SPECTRA OF MAN. Kovtun, A. N.; Kryzhova, G. I.; Moroz, G. L. pp 205-210 of Prikladnaya Yadernaya Spektroskopiya. Latyshev, G. D. (Ed.). Moscow; Atomizdat (1974). (In Russian).

In the analysis of the γ spectra of a ^{137}Cs source in a water phantom taken under various geometries, differences in the spectra were observed only in the total absorption peak and the scattering peak whereas the form and intensity of the continuous Compton distribution remained practically the same. These differences are additions to the two peaks. The processing of the radiation spectra of man leads to a search for the optimum ratio of the calibrated and supplementary spectra while maintaining a minimum deviation of the superposed Compton spectra from the spectra studied. The calibrated spectra have data on the form and intensity of the Compton part and therefore on the activity of isotopes. The role of the supplementary spectra of the additions to the total absorption peak and the scattering peak leads to a compensation of the differences in the form of the investigated and calibrated spectra. This is the essence of the compensation method. In order to test the method, the instrumental γ spectra of ^{203}Hg, ^{137}Cs, and ^{60}Co at different locations in the water phantom were measured and compensated. The results showed that the method eliminates the errors in the usual methods caused by lack of knowledge of the distribution of the radioactive materials and its changes with time. (JSR)

27787 DIFFUSION CONSTANT AND SURFACE STATES OF POSITRONS IN METALS. Paulin, R.; Ripon, R. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)); Brandt, W. (New York Univ., N. Y. (USA)). Appl. Phys.; 4: No. 4, 343-347 (Aug 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

Positron lifetime spectra and angular correlation curves for seven fine-grained powders of Fe, Co, Ni, and W are analyzed. From the lifetime data, the positron diffusion constant in metals at T = 300 K was found to be $D = (1.0 \pm 0.5) \times 10^{-2}$ cm^2 sec^{-1}. Evidence is presented that positrons are trapped in metal surface states. (auth)

27788 BREMSSTRAHLUNG, TRANSITION, AND CHERENKOV RADIATION OF HIGH ENERGY γ QUANTA. Baryshevskii, V. G.; Ngo Tan Nan. (Belorussian State Univ., Minsk). Yadern. Fiz.; 20: No. 6, 1219-1222(Dec 1974). (In Russian).

The ratio of the intensities of the bremsstrahlung and transition radiation in the photon high-energy region (GeV and higher) is discussed. It is shown that in that region the emission proceeds mainly via transition radiation for electron energies $\sim 10^{14}$ eV. It is noted that pair production sometimes leads to the Cherenkov radiation of high-energy γ quanta in a homogeneous isotropic medium. The transition radiation of resonance γ quanta is discussed. (auth)

27789 GAMMA DOSES MEASUREMENTS IN A HUMAN PHANTOM USING THERMOLUMINESCENT DOSIMETER. Yoo, Y. S.; Lee, H. D. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 6: No. 4, 239-247(Dec 1974).

A human phantom of polyethylene has been designed and sculptured for studying the effective radiation safety control. The phantom has the approximate size of the Korean adult and was sliced into thirty-five transverse slabs, 2.5 cm thick. The relative dose at the specified position was determined from the exposure that a TLD badge worn on the surface of the phantom body received from external γ-ray. The variation of the exposure as a function of depth in the phantom was measured for uncollimated γ-ray using TLD rods, and also isodose curves were obtained for the anatomical cross-section of the critical organs of the body. To simulate radiation exposure condition in the nuclear facility, measurements were made for given angles of incident γ-ray. The front to back attenuation factor for human phantom of thickness 20 cm was 0.439 for ^{137}Cs γ-ray which is in reasonable agreement with the published data. (auth)

27790 VELOCITY DEPENDENCE OF TRANSIENT HYPERFINE FIELDS FOLLOWING COULOMB EXCITATION. Gibb, A. W. M. Hamilton, Ont.; McMaster Univ. (1973). 190p.

Thesis.

The velocity dependence of the transient magnetic field that is experienced by ions while slowing down in polarized ferromagnetic materials is studied. Targets of $Fe_{80}Rh_{20}$, $Fe_{70}Pd_{30}$, and $Fe_{85}Pt_{15}$ alloys were bombarded by 50- to 10-MeV alpha-particle, 35-MeV ^{16}O, and 20-MeV ^{12}C beams. The precession angles of Coulomb-excited rhodium, palladium and platinum nuclei that recoil and stop in the ferromagnetic target were measured using the technique of perturbed angular distributions following Coulomb excitation. The singles mode, in which gamma ray events are accepted irrespective of projectile scattering angle, was employed. A detailed theoretical analysis was developed to indicate how the double average over projectile scattering angle and energy required in a thick-target singles experiment would modify the observed rotation angle. Calculations were carried out using the Coulomb excitation theory of Alder et al. and the transient field theory of Lindhard and Winther. Indirect feeding of a nuclear state, by Coulomb excitation of a higher-energy state and subsequent decay to the state of interest, was found to modify the observed precession angle of the state. (CA)

27791 FRAGMENTATION OF HIGH-ENERGY OXYGEN-ION BEAMS IN WATER. Maccabee, H. D.; Ritter, M. A. (Univ. of California, Berkeley). Radiat. Res.; 60: No. 3, 409-421(Dec 1974).

Energy-deposition spectra of oxygen-ion beams of up to 250 MeV/nucleon were obtained in silicon semiconductor detectors at the Lawrence Berkeley Laboratory Bevatron. The removal of primaries in water and their fragmentation into nitrogen, carbon, and boron ions were measured. The mean free path of fast oxygen ions in water is 19.4 ± 1.3 cm, corresponding to a total cross section of 1.55 b "per molecule." The partial cross sections for production of fragments are 331 ± 140 mb for nitro-

gen, 324 ± 64 mb for carbon, and 102 ± 14 mb for boron. Calculations of fluence and depth–dose distributions based on the fragmentation data are in good agreement with experimental results. Also presented are measurements of energy deposition of oxygen beams stopping in silicon and germanium and measurements of the effect of nuclear interactions occurring in the semiconductor detectors themselves. (auth)

Radiation Protection Standards

27792 THERE IS NO PARADOX IN THE EXPOSURE TO ENERGY FLUENCE CONVERSION. Koblinger, L. (Kozponti Fizikai Kutato Intezet, Budapest). Phys. Med. Biol.; 19: No. 6, 885-886(Nov 1974).

The apparent paradox relating to the "energy fluence per roentgen" conversion when "86.9 erg absorbed when only 18.8 erg is carried by the beam" (McDavid, W. D., and Waggener, R. G., Phys. Med. Biol.; 19: 391(1974) was incorrectly resolved by these authors. McDavid and Waggener did not take into account the definition of energy fluence given by the ICRU (1971, Radiation Quantities and Units, ICRU Report 19, Washington D. C.) as the "quotient of dE_Π by da, where dE_Π is the sum of energies, ..., of all the particles which enter a sphere of cross sectional area da," and that the published exposure to energy fluence conversion formulas are valid if fluence and exposure are defined on the surface and inside an infinitesimal volume element around the point concerned, respectively. Further clarification is then provided by a derivation of the conversion formula and its application to the examples used by McDavid and Waggener. (UK)

Radiation Source Calibration and Standardization

Refer also to abstract 25833.

27793 SPECIAL STATE STANDARD FOR UNIT NEUTRON FLUX DENSITY IN THE MEASUREMENT RANGE OF NUCLEAR PHYSICS INSTALLATIONS. Vasil'ev, R. D.; Yaryna, V. P.; Sevast'yanov, V. D. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 7, 990-995(Jul 1974).

Translated from Izmer. Tekh.; 17: No. 7, 10-14(Jul 1974).

The special state standard for unit neutron flux density was established on the basis of a modernized neutron generator, type NG-160. It ensures the reproduction of the unit of thermal neutron flux density in the range of 10^9 to 10^{11} n/s · cm^2 for diffused and 10^6 to 10^9 n/s · m^2 for directional radiation, and of the unit of neutron flux density with energy of 14.5 ± 0.1 MeV in the range of 10^9 to 10^{11} n/s · m^2 for directional neutron radiation. This standard is intended for neutron measurements at nuclear physics installations. The neutron source is the T(d,n)^{4}He reaction. The thermal neutron source, the source of neutrons with energies of 14.5 MeV, the measuring equipment of the standard, and the auxiliary equipment of the standard are described. Special attention is paid to determining the spatial angle and energy characteristics of the neutron field in studying thermal-neutron sources. The random error in reproducing the unit flux density of neutrons with an energy of 14.5 MeV did not exceed 0.3%; the resulting value of the nonexcluded systematic error amounted to 0.5%. In conclusion, meteorological provisions for neutron measurements at nuclear physics installations are discussed. (3 figures, 1 table) (RWR)

27794 GUARANTEE OF UNITY OF MEASUREMENTS OF NUCLIDE ACTIVITY. Sereni, A.; Zsdansky, K.; Karavaev, F. M. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 6, 875-877(Jun 1974).

Translated from Izmer. Tekh.; 17: No. 6, 39-41(Jun 1974).

Work on the intercalibration of national standards of nuclide activity in the COMECON countries is reviewed. Procedures used and some of the attendant problems are discussed. The work was done with ^{60}Co and ^{137}Cs sources. (2 tables) (RWR)

Shielding Calculations and Experiments

Refer also to abstracts 28133, 28211, 28517–28519, 28536, 28613, 28626, and 28631.

27795 REQUIREMENTS ON THE CONCRETE AND THE CONSTRUCTION OF REACTOR SHIELDS FROM REINFORCED CONCRETE. Korenevskii, V. V.; Pergamenshchik, B. K.; Perevalov, V. S. Vop. Fiz. Zashch. Reaktorov; No. 6, 191-196(1974). (In Russian).

The special requirements placed on reinforced concrete shields exposed to a high radiation flux are discussed with respect to materials and construction. The radiation stability of concrete is examined. The requirements imposed for concrete fillers are also considered. (JSR)

27796 USE OF BARIUM-SERPENTINITE CEMENT IN SHIELDS FOR REACTORS IN NUCLEAR POWER PLANTS. Voskresenskii, E. V.; Egorov, Yu. A.; Zaalishvili, G. G.; Kutateladze, K. S.; Lekishvili, R. A.; Pankrat'ev, Yu. V.; Piskunov, V. I. Vop. Fiz. Zashch. Reaktorov; No. 6, 197-206(1974). (In Russian).

The results of the study of the physical-mechanical and shielding properties of thermostable materials of barium-serpentine and iron-barium-serpentine cement rocks were reported in graphs and tables and discussed. The studies showed that these materials are very effective for the biological shields of nuclear power plant reactors. They maintain their shielding properties at temperatures up to ~450°C. (JSR)

27797 SHIELDING PROPERTIES OF CONCRETES OF DIFFERENT COMPOSITION. Veselkin, A. P.; Voskresenskii, E. V.; Egorov, Yu. A.; Pankrat'ev, Yu. V.; Piskunov, V. I.; Staurin, N. V. Vop. Fiz. Zashch. Reaktorov; No. 6, 207-221(1974). (In Russian).

The shielding properties of 15 different concretes for reactor radiation was studied by the usual methods. The concretes studied can be divided into four types: normal concretes, hydrate concrete, heavy concretes, and concretes with serpentine fillers. The neutron spectra in the concrete shields, attenuation of fast neutron flux, attenuation of the neutron and γ dose rate, and accumulation of moderated neutrons, were measured for the concretes and the results are reported graphically and in tables. The effect of boron on the shielding properties of concrete was also studied. (JSR)

27798 CALCULATION OF THE TEMPERATURE FIELD IN BIOLOGICAL SHIELDS BY THE METHOD OF ELECTROTHERMAL ANALOGY. Demeshev, R. S.; Rekshnya, N. F. Vop. Fiz. Zashch. Reaktorov; No. 6, 59-63(1974). (In Russian).

The simulation of the temperature field in biological shield by the use of the electrothermal analogy method was made on a specialized electrointegrator. The procedure used and the results obtained are briefly indicated. The results show that the method is quite useful during the construction stage for biological shields. (JSR)

27799 OPTIMUM SHADOW MULTILAYER REACTOR SHIELDING. Sakovich, V. A.; Sakharov, V. M. Vop. Fiz. Zashch. Reaktorov; No. 6, 63-69(1974). (In Russian).

Parametric calculations were made of the optimum shadow shielding of a reactor with consideration of the formation in the shield of capture gamma rays. The method provides for the calculation of dose under the assumption that the area to be shielded is a significant distance from the reactor and shield. The shield consists of six spherical layers, the last of which is hydrogen-containing. (JSR)

27800 PASSAGE OF γ RADIATION FROM A POINT SOURCE WITH RANDOM ANGULAR DISTRIBUTIONS OF THE QUANTA THROUGH CURVED CHANNELS IN THE SHIELDING. Zolotukhin, V. G.; Efimenko, B. A.; Klimanov, V. A.; Kochanov, V. A.; Mashkovich, V. P.; Orlov, N. Yu. Vop. Fiz. Zashch. Reaktorov; No. 6, 78-82(1974). (In Russian).

The shaping of γ radiation fields in curved channels in a shield was calculated for sources with a given angular distribution of the γ quanta. The Monte Carlo parametric method was used for the solution of the problem. Relations were derived which make it possible to combine the distribution of the radiation field in the second or subsequent section of the channel for sources with the given angular distribution with distribution for isotropic sources. (JSR)

27801 CRITERIA FOR THE OPTIMIZATION OF THE FORM OF RADIATION SHIELDING. Goryachev, I. V.; Kuznetsov, V. G.; Sakovich, V. A. Vop. Fiz. Zashch. Reaktorov; No. 6, 69-72(1974). (In Russian).

The optimization of the form of one of the surfaces of the shield (with the other surfaces having any profile) was examined for cases where the radiation method of dose calculation or the method of integration of the radiation emitted by the surface of the shield can be used. Approximate methods were obtained for verification of the optimization of the shield. (JSR)

27802 COMPLEX METHOD OF CALCULATING THE SHIELDING OF NUCLEAR REACTORS. Veselkin, A. P.; Gur'eva, N. A.; Netecha, M. E.; Nikitin, A. V. Vop. Fiz. Zashch. Reaktorov; No. 6, 7-10(1974). (In Russian).

The computer program NEGA was developed for the calculation of the different functional neutron and γ fields in reactor shields. The program consists of three basic parts: block for the calculation of group neutron flux and functionals of the neutron flux in the shield, block for the calculation of the primary and secondary γ flux and functionals of the γ flux in the shield, and a library of the multigroup constants. Each of these are discussed. (JSR)

27803 USE OF THE KOROBOV METHOD FOR THE CALCULATION OF SHIELDING FROM IRRADIATION. Gogotova, L. F.; Nikitin, A. V. Vop. Fiz. Zashch. Reaktorov; No. 6, 10-14(1974). (In Russian).

The TSILINDR-2, KUB-2, and KUB-3 programs for the calculation of shielding are all based on the Korobov method. The results obtained with the three programs are compared. The dependence of the particle flux density on the number of integration points was shown. The accuracy of the calculations substantially depends on the small number of integration points. (JSR)

27804 PASSAGE OF NEUTRONS OF INTERMEDIATE ENERGY THROUGH SHIELDS WITH COMPLEX HETEROGENEITIES. Bolyatko, V. V.; Sakharov, V. M.; Suvorov, A. P.; Kharizomenov, Yu. V. Vop. Fiz. Zashch. Reaktorov; No. 6, 98-108(1974). (In Russian).

The transmission of intermediate-energy neutrons through iron-serpentine concrete and through offset slits in the concrete was measured experimentally at the Bilibinsk nuclear power plant. The experimental values obtained were compared with results from one-dimensional calculations by the discrete ordinate method using the ROZ-1 program. Good agreement between experimental and theoretical results was obtained for the spatial distribution of the neutrons. The type of concrete studied attenuated the intermediate neutron flux more effectively than the fast neutron flux. (JSR)

27805 YIELD OF CAPTURE γ RADIATION FROM AN IRON LAYER DURING OBLIQUE INCIDENCE OF NEUTRONS. Degtyarev, S. F.; Repin, N. N.; Sakovich, V. A.; Sakharov, V. M.; Suvorov, A. P.; Tarasov, V. V. Vop. Fiz. Zashch. Reaktorov; No. 6, 108-110(1974). (In Russian).

A theoretical and experimental study was made of the dependence of the capture gamma radiation yield on the angle of incidence of neutrons. A comparison of the spectra obtained showed that their form does not depend on the angle of incidence of the neutrons or on the angle at which the γ quanta are released from the shield. The difference obtained in the experimental and theoretical results lies within the limits of error of the measurements. (JSR)

27806 FIELD OF CAPTURE γ RADIATION IN SOLID SHIELDS. Bolyatko, V. V.; Gorbatov, V. S.; Reitblat, V. L.; Tkachenko, V. V.; Khokhlov, V. F.; Tsypin, S. G. Vop. Fiz. Zashch. Reaktorov; No. 6, 111-116(1974). (In Russian).

The spatial energy distribution of capture γ radiation in solid shields of iron–serpentine concrete, stainless steel, and ferric-ferrous oxides was measured by thermoluminescent dosimeters. The results obtained and previous results for water, boron carbide, and serpentine rocks were analyzed and generalized. The results obtained are shown graphically as a function of the shield thicknesses. (JSR)

27807 FIELD OF NEUTRONS REFLECTED FROM SHIELDS OF DIFFERENT THICKNESS. Egorov, Yu. A.; Zharkov, V. P.; Orlov, Yu. V. Vop. Fiz. Zashch. Reaktorov; No. 6, 120-129(1974). (In Russian).

The angular distribution of reflected neutrons was measured experimentally for polyethylene, titanium hydride, lithium hydride, aluminum, titanium, graphite, and lead. The experimental installation, using neutrons from the active zone of the reactor, was described in detail. The results obtained are shown graphically for different shield thicknesses. (JSR)

27808 RADIATION HEAT RELEASE IN THE CONSTRUCTION MATERIAL OF SHIELDS PLACED IN A LIGHT MEDIUM. Avaev, V. N.; Efimov, E. P. Vop. Fiz. Zashch. Reaktorov; No. 6, 130-134(1974). (In Russian).

The purpose of the present study is the experimental verification of the assumption that the accepted method for the calculation of the heat release gives the accuracy required. The experimental-computational study included the experimental determination of the magnitude of the heat release in reactors in samples of steel and lead of different geometric forms embedded in polyethylene shields, the Monte Carlo calculation of the spectral composition of the γ radiation for polyethylene shields, and Monte Carlo calculation of the heat release per gram of substance in lead and iron cylindrical rings of different thickness embedded in polyethylene. The experimental results are shown graphically. Comparison of experimental and calculated data show that the accepted method of calculation makes it possible to determine satisfactorily the heat release in construction materials of any geometric form placed in a light medium. For any material the dimensions are the determining factors in the magnitude of the heat release. In the general case the magnitude of the heat release depends on the product of the dimensions, the absorption coefficient for γ quanta, and the density. (JSR)

27809 USE OF THE SUBGROUP METHOD FOR CALCULATION OF THE RESONANCE STRUCTURE OF THE CROSS SECTION IN THE CALCULATION OF THE PASSAGE OF NEUTRONS THROUGH FLAT SHIELDING LAYERS. Germogenova, T. A.; Isaev, N. V.; Nikolaev, M. N.; Khokhlov, V. F. Vop. Fiz. Zashch. Reaktorov; No. 6, 14-20(1974). (In Russian).

Calculations on the PROZA program showed that uncorrected computation of the resonance structure of the cross section on the basis of the mean-group resonance coefficient of the shielding leads to significant errors in the calculation of the integral characteristics of the shield, primarily at small optical thicknesses of the layers. The use of the subgroup method in shielding calculations greatly increases the accuracy of the calculations, principally in regions of allowed and forbidden resonances. (tr-auth)

27810 SPATIAL AND ANGULAR DISTRIBUTION OF FAST NEUTRONS IN FINITE SHIELDING. Bass, L. P.; Germogenova, T. A.; Dubinin, A. A.; Khmylev, A. N. Vop. Fiz. Zashch. Reaktorov; No. 6, 29-37(1974). (In Russian).

The problem of solving the spatial and angular distribution of fast neutrons in shields represented by the frustum of a cone is examined. The method for the numerical solution of the transport equations is described. Numerical results obtained with the RZD (Rezeda) program on the effect of the size of the energy interval and of the precision of the scattering curves on the calculation of a fast neutron field and on the calculation of fast neutron fluxes in cones irradiated by monoparallel beams are shown graphically and discussed. (JSR)

27811 USE OF PHOTOMETRY METHODS AND THE THEORY OF RADIANT HEAT EXCHANGE AS APPLIED TO THE TRANSFER OF IONIZING RADIATION. Mironov, V. N. Vop. Fiz. Zashch. Reaktorov; No. 6, 37-43(1974). (In Russian).

The suitability of applying the basic theorems of photometry and the theory of radiant heat exchange to the study of the transport of ionizing radiation was shown. Special attention was given to the transport of ionizing radiation through different inhomogeneous inclusions in the shielding barrier. The attenuation of the radiation by geometric factors was considered. (JSR)

27812 COMPARISON OF DINE NEUTRON ATTENUATION CALCULATIONS WITH EXPERIMENTAL RESULTS FOR A WIDE VARIETY OF SIMULATED CONCRETE CONFIGURATIONS FOR A FAST AND THERMAL REACTOR SPECTRUM. Verschuur, K. A. (Stichting Reactor Centrum, Petten, Netherlands). pp 996-1008 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

In the small shielding facility KAF measurements have been done in 86 cm of iron and in simulated concrete configurations of about 66 cm thickness, with and without an iron filter to simulate a fast reactor spectrum. These measurements have been used to test the neutron shielding program DINE for the first part of a reactor shield. DINE is a removal-diffusion code with multigroup difference equations developed to give an improvement in the calculation of the deep penetration of diffusing neutrons. To demonstrate the improvement by this method calculations have been done also with a version of DINE using ordinary diffusion theory. (FR)

PHYSICS (THEORETICAL)

General

Refer also to abstract 28910.

27813 (AD-781069) CONTINUED FRACTION METHODS FOR DEGENERATE PERTURBATION THEORY. Technical Report, January–July 1972. Scofield, D. F. (National Research Council, Washington, D. C. (USA)). Mar 1974. Contract F18600-73-C-0066. 131p. (ARL-74-0024). NTIS $4.75.

The operator which gives the level shift from the unperturbed to the perturbed system is shown to satisfy a quadratic equation in a banach space. This quadratic equation is solved using a continued fraction approach and using Newton's method. The asymptotic expansion of the solution using the continued fraction method is shown to be equivalent to the Rayleigh-Schroedinger perturbation expansion. The theory is developed so as to be applicable to the degenerate perturbation problem. Several extensive numerical calculations are reported which show the superiority of the method compared to Rayleigh-Schrödinger perturbation theory, Feenberg perturbation theory and Brillouin-Wigner perturbation theory. (auth)

27814 (RLO-2041-122) DETERMINATION OF AMPLITUDES FROM OBSERVABLES IN QUANTUM MECHANICAL SYSTEMS. Goldstein, G. R.; Moravcsik, M. J. (Tufts Univ., Medford, Mass. (USA). Dept. of Physics; Oregon Univ., Eugene (USA)). [nd]. 24p. Dep. NTIS $4.25.

A rigorous proof is given for the prescription, published previously, which tells whether a given set of experimental observables for a quantum mechanical system uniquely determines the amplitudes describing that system or not. (auth)

27815 (STI/PUB-355(Vol.1)) GLOBAL ANALYSIS AND ITS APPLICATIONS. Volume I. Lectures Presented at an International Seminar Course, Trieste, Italy, July 4–August 25, 1972. (International Atomic Energy Agency, Vienna (Austria)). Aug 1974. 238p. (CONF-720746-P1). IAEA $11.00.

The lectures on global analysis cover smooth manifolds and maps, fibre bundles, holomorphic function theory and complex manifolds, advanced calculus, elliptic operators, and Riemannian geometry. (JFP)

27816 (STI/PUB-355(Vol.2)) GLOBAL ANALYSIS AND ITS APPLICATIONS. Volume II. Lectures Presented at an International Seminar Course, Trieste, Italy, July 4–August 25, 1972. Sep 1974. 369p. (CONF-720746-P2). IAEA $17.00.

The lectures cover geometric variational problems from a measure-theoretic point of view, area measures on a real vector space, the differentiability of transformations which preserve geodesics, stability theorems for R^2-actions on manifolds, introduction to minimal-surface theory, complex varieties of nilpotent Lie algebras, infinite-dimensional Lie groups acting on finite-dimensional manifolds, some properties of infinite-dimensional orthogonal groups, theory of residues in several variables, connections, introduction to global calculus of variations, elementary survey of pseudo-differential operators and the wave-front set of a distribution, and boundary value problems for nonlinear partial differential equations. Also discussed are Gaussian measures on Banach spaces and manifolds, sheaf cohomology, structures on manifolds and vanishing theory, complex analysis on Banach spaces, modern theory of billiards, quasi-Abelian manifolds, the Bernstein problem, invariants of foliations, the local solvability of linear partial differential equations, compact operators and the minimax principle. Rigidity and energy, phase transitions in D-dimensional Ising lattices, differential calculus in locally convex spaces, singularities in soap bubbles and soap films, caustics, the topological degree on Banach manifolds, existence and nonexistence for semi-linear elliptic equations, a strange three-dimensional surface in ϕ^2, continuous change of topological type of Riemannian manifolds, and regularity of solutions of elliptic differential operators. (JFP)

27817 (STI/PUB-355(Vol.3)) GLOBAL ANALYSIS AND ITS APPLICATIONS. Volume III. Lectures Presented at an International Seminar Course, Trieste, Italy, July 4–August 25, 1972. (International Atomic Energy Agency, Vienna (Austria)). Nov 1974. 339p. (CONF-720746-P3). IAEA $15.00.

The lectures cover the vanishing theorem for a positive holomorphic vector fiber, fiber parallelism and locally reductive spaces, semi-analytic sets, controllability, differential form and systems, the sufficiency of jets of maps from a Hilbert space to the real line, survey of coincidence theory, variations on a theme of Plateau, weak topology on functional manifolds, non-subjectivity of a given function as an operator on the space of analytic functions on ^{3}Ir, global existence theorems for a partial differential equation of the first order, symplectic mechanics, nonlinear Hodge theory, invariant measures for continuous transformations, mean curvature, structural stability in manifolds with boundary F–S manifolds in the theory of geodesic fields, Gevrey hypoellipticity for subelliptic boundary value problems, cohomology of Lie algebras, and solved and unsolved problems in mathematical physics. Also discussed are degree theory and nonlinear partial differential equations, Riemannian pinched manifolds, the cohomology structure of a Riemannian s-manifold, Lorentz geometry, the Laplace transform of tempered distributions, entropy theory of measure-preserving transformations, smooth partitions of unity and extension theorems, strange attractors, Paul Schweitzer solution of the Seifert problem, and topological decompositions of operator algebras. (JFP)

27818 THE RELATION BETWEEN EMISSION AND ABSORPTION COEFFICIENTS FOR ARBITRARY RADIATION PROCESSES. Oster, L. (Bonn Univ. (F. R. Germany). Inst. fuer Astrophysik und Extraterrestrische Forschung). Astron. Astrophys.; 33: No. 1, 151-152(Jun 1974).

A universally applicable rule that allows the computation of absorption from emission coefficients and vice versa is presented, and the synchrotron case is treated as an example. (auth)

27819 PERIODIC FIELDS IN FIVE-DIMENSIONAL RELATIVITY. Leibowitz, E.; Rosen, N. (Technion-Israel Inst. of Tech., Haifa). Gen. Relativity Gravitation; 5: No. 4, 409-427(Aug 1974).

The concept of periodic fields in the framework of five-dimensional relativity is introduced in a 5-covariant manner. An analysis is given of periodic scalar, vector and bivector fields. The resulting 4-dimensional theories are examined, and it is found that some of them correspond to familiar physical theories in space-time, whereas others require further investigation. (auth)

27820 ELECTROMAGNETIC WAVES IN A PLANE WAVE BACKGROUND. Clemens, G.; Stephani, H. (Frederich-Scheller-Univ., Jena, Ger.). Gen. Relativity Gravitation; 5: No. 4, 479-481 (Aug 1974).

Source-free Maxwell equations are equivalent to the scalar wave equation. Most of its solutions are singular at infinity. If the null eigenvector of the background metric is an eigenvector of the Maxwell field, too, the e.m. field is not changed by the plane wave. (auth)

27821 MEASUREMENT IN QUANTUM MECHANICS, AND THE EPR PARADOX. Zweifel, P. F. (Virginia Polytechnic Inst., Clacksburg). Int. J. Theor. Phys.; 10: No. 1, 67-72 (Jul 1974).

The various theories which have been posed in considering the problem of measurement in quantum mechanics are summarized and it is pointed out that the basic difficulty which has focused so much attention on the subject is the occurrence, in quantum mechanics, of coherent states and the fact that measurements destroy coherence. The question "Is the quantum mechanical description of nature complete?" was first raised in a famous paper (Einstein, Podolsky and Rosen (Phys. Rev.; 47: 777 (1935)). This "EPR Paradox" has been discussed by many authors over the subsequent years. The purpose of this note is to show that if one accepts the Wigner theory of measurement (American J. Phys.; 31: 6(1963)) in which a measurement is defined to have taken place only when an animate observer could in principle obtain the result, the EPR paradox can be avoided completely. The Wigner theory requires some sort of "interaction" between the system being measured and the mind of the observer. This very interaction can be used to resolve the EPR paradox in a non-paradoxical way. (UK)

27822 HISTORY OF QUANTUM THEORY. Hund, F. London; Harrap (1974). vp.

Translation of Geschichte der Quantentheorie Mannheim, Bibliographisches Institut AG, 1967.

The subject is dealt with in chapters which include the following titles as well as some more general introductory topics: quantization of periodic motion; interpretation of simple spectra; structure of the atom and properties of the elements; towards electron spin; matrix version of quantum mechanics; the matter wave and the Schroedinger equation; completion of quantum mechanics; exploitation of symmetry; applications and further developments of quantum mechanics. (UK)

27823 COMMENT ON RAPID NUMERICAL SOLUTION OF THE ONE DIMENSIONAL SCHROEDINGER EQUATION. Thorson,

W. R. (Univ. of Alberta, Edmonton). Can. J. Phys.; 52: No. 24, 2509-2510(15 Dec 1974).

In a recent article Wills alleges that the method for rapid numerical solution of the one dimensional Schrodinger equation devised by Newman and Thorson "is equivalent to the well known phase-amplitude method". A critique of this opinion is given. (auth)

27824 NOTE ON "LIFETIME EFFECTS IN COUPLED CHANNEL PROBLEMS." Nakamura, K. (Univ. of Alberta, Edmonton). Can. J. Phys.; 52: No. 24, 2506-2508(15 Dec 1974).

The simple field theoretical model of coupled channel problems proposed by Kamal and Kreuzer is solved in the Tamm-Dancoff approximation. Some comments are made on their method of inclusion of self energy effects in the unstable particle propagator. (auth)

27825 INTRODUCING QUANTUM PHYSICS. Ogborn, J. (Chelsea Coll. of Science and Tech., London). Phys. Educ.; 9: No. 7, 436-443(Nov 1974).

Ways of introducing quantum ideas at various times and in various ways through the Nuffield advanced physics course are considered. Quantum ideas appear in several places in the course viz.; (1) X-ray diffraction and crystal structure, (2) Energy levels, (3) Rutherford model of the atom, (4) Optics and photons, (5) Wave-particle duality, and (6) Standing wave models of the atom. Methods of approaching the teaching of these quantum concepts are discussed. (UK)

27826 FINE TOPOLOGIES FOR MINKOWSKI SPACE. Williams, G. (Stetson Univ., De Land, FL). Proc. Cambridge Phil. Soc.; 76: 503-509(Nov 1974).

Fine topologies are discussed for Minkowski space. The conformal group and projective group have representations as C^1 groups of homeomorphisms of various topologies. (auth)

27827 SPINNING AXIS REPRESENTATION. de Azcarraga, J. A. (Facultad de Ciencias, Salamanca, Spain); Navarro, L. J. Math. Phys. (N.Y.); 16: No. 2, 243-246(Feb 1975).

A new spinning axis representation is introduced. It allows one to calculate the evolution operator of a system with slowly varying time-dependent Hamiltonian with the desired degree of approximation in the parameter used for describing its dynamical evolution. The procedure is compared with a previously existing one and applied to a simple example. (auth)

27828 APPLICATION OF NONSTANDARD ANALYSIS TO QUANTUM MECHANICS. Farrukh, M. O. (Imperial Coll. of Science and Tech., London). J. Math. Phys. (N.Y.); 16: No. 2, 177-200(Feb 1975).

Quantum mechanics is formulated using a nonstandard Hilbert space. The concept of an eigenvector of a linear operator, which applies to standard as well as nonstandard Hilbert spaces, is replaced by the more general concept of an ultra eigenvector, which applies to nonstandard Hilbert spaces alone. Ultra eigenvectors corresponding to all spectral points of internal self-adjoint operators are proved to exist. This result enables one to set up a formalism which is equally valid for the discrete, as well as the continuous spectrum. Finally, Dirac's formalism is reproduced, in a rigorous form within the nonstandard Hilbert space structure. (auth)

27829 FUNCTIONAL INTEGRATION, PADE APPROXIMANTS, AND THE SCHROEDINGER EQUATION. Bove, A. (Univ., Bologna); Fano, G.; Turchetti, G.; Teolis, A. G. J. Math. Phys. (N.Y.); 16: No. 2, 268-270(Feb 1975).

A method for finding the eigenvalues and the eigenvectors of the Schroedinger equation is presented. If $H = T + V$ is an M-body Hamiltonian, one uses Trotter's formula in the form $e^{-\beta T/n}\, e^{-\beta V/n} \sim e^{-\beta H/n}$ (for n large). This allows the computation of the matrix elements of $e^{-\beta H}$ in the configuration representation, and the moments $\mu_r = (\psi, (e^{-\beta H})^r \psi)$ $(r = 1,2,\ldots)$ for any wave function ψ. From the moments μ, one computes the $[N-1/N]$ Padé approximant, whose poles are the approximate eigenvalues of $e^{-\beta H}$. The convergence of the method is proved and asymptotic formulas for the matrix elements of $e^{-\beta T}$ projected on states of given angular momentum are derived. (auth)

27830 EXACT PROPAGATOR FOR A TIME-DEPENDENT HARMONIC OSCILLATOR WITH AND WITHOUT A SINGULAR PERTURBATION. Khandekar, D. C.; Lawande, S. V. (Bhabha Atomic Research Centre, Bombay). J. Math. Phys. (N.Y.); 16: No. 2, 384-388(Feb 1975).

By using Feynman's definition of a path integral, exact propagators for a time-dependent harmonic oscillator with and without an inverse quadratic potential were evaluated. It is shown that these propagators depend only on the solutions of the classical unperturbed oscillator. The relations between these propagators, the invariants, and the Schroedinger equation are also discussed. (auth)

27831 GREEN'S FUNCTION METHODS IN PROBABILITY THEORY. Keilson, J. Griffin's Statistical Monographs and Courses. New York; Hafner Publishing Company (1965). 228p.

The topics discussed are homogeneous Markov processes, conjugate transformation and asymptotic behavior, the passage problem for homogeneous skip-free processes, bounded processes and ergodic Green functions, ergodic distributions, ruin problems, and extremes, and processes with representation of finite dimension. (JFP)

27832 DETERMINATION OF THE DENSITY OF ELECTRON MOMENTUM DISTRIBUTIONS IN MATTER BY THE ANNIHILATION OF POSITRONS. Aref'ev, K. P.; Vorob'ev, S. A.; Etin, G. I. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fis.; No. 8, 103-109(1974). (In Russian).

A method was developed for the reduction of the density function of annihilating electron-positron pairs from data on the angular correlation of annihilation γ quanta. On the basis of the proposed mechanism for the annihilation of positrons the electron density function of matter was determined from the time spectra of the positron lifetime and the angular distribution of the annihilation γ pair. (tr-auth)

27833 WIGNER'S QUANTUM DISTRIBUTION FUNCTION IN CYLINDRICAL COORDINATES. Denisova, N. A.; Kon'kov, V. L. (Gorky State Univ., USSR). Teor. Mat. Fiz.; 22: No. 1, 64-71 (Jan 1975). (In Russian).

The definition of Wigner's quantum distribution function in cylindrical coordinates is given. The kinetic equation for this function is written down and equilibrium distribution for the case of noninteracting electron gas placed into the magnetic field and localized by means of external forces is found. (auth)

27834 GENERATING FUNCTIONALS IN NON-EQUILIBRIUM STATISTICAL MECHANICS OF THE NON-IDEAL FERMI GAS. Auslender, M. I.; Kalashnikov, V. P. (Inst. of Metal Physics, Moscow). Teor. Mat. Fiz.; 22: No. 1, 46-63(Jan 1975). (In Russian).

Equation of motion for the nonequilibrium generating functional (GF) of the system of interacting fermions is constructed. The solution of this equation, satisfying the correlations weakening condition in infinitely distant past and depending upon the time only through the one-particle density matrices, is found. Perturbation theory for the GF with respect to small interaction and small density of particles is developed, which is based on the iterative expansion of integral equations for the GF. The relation of the technique developed to the N. N. Bogoliubov method in the theory of nonideal gas is discussed. (auth)

27835 ANSWER TO A NOTE BY STRNAD AND KODRE ON THE CLASSICAL THEORY OF TACHYONS. Recami, E.; Modica, E. (Univ., Catania, Italy). Lett. Nuovo Cim.; 12: No. 8, 263-265(22 Feb 1975).

In answer to previous questions it is stated that the fact that light speed is or is not the maximal speed does not play any essential role in deriving special relativity and that no inconsistency can be found in the classical theory of tachyons as regards tachyonic signal transmission. (JFP)

27836 TACHYON COSMOLOGY. Ray, J. R. (Clemson Univ., SC). Lett. Nuovo Cim.; 12: No. 8, 249-252(22 Feb 1975).

A simple tachyon dust solution associated with a metric that allows only tachyon dust is presented and discussed. The invariant-momentum flux is an oscillating function of a spatial coordinate which develops singularities every time $z = 4n\pi$ for $n = 0, \pm1, \pm2, \ldots$. The solution is analogous to the oscillating Friedmann solution. A discussion is presented showing that this tachyon metric supports the view that the universe could expand as a tachyon universe at each singularity. (JFP)

27837 SECOND VIRIAL COEFFICIENT AND POLES OF THE S-MATRIX. Nussenzveig, H. M. (Univ. Paris-Sud, Orsay, France). Acta Phys. Austr.; 38: No. 2, 130-144 (1973).

A new representation for the second virial coefficient of a quantum gas with finite-range interactions, in terms of the poles of the S-matrix, is given. It is specially suitable for discussing the low-temperature behavior. The behavior as a function of temperature and coupling strength is discussed in several situations, including effective range expansions and the effects due to bound states, antibound states and resonances. Causality implies that the low-temperature second virial coefficient is bounded by that for a hard-sphere gas with the same interaction range. (auth)

27838 ELEMENTARY CONCEPTS OF QUANTUM THEORY. Warren, J. W. (Brunel Univ., Uxbridge, Eng.). Phys. Educ.; 9: No. 7, 444-448(Nov 1974).

Quantum theory comprises a number of physical concepts and methods of calculation applicable to bodies on an atomic scale and consequently to the explanation of the properties of macroscopic bodies in terms of the behavior of their constituent particles. In advanced work the theory is highly mathematical, but at an elementary level the difficulties lie mostly in the appreciation of the relevant physical ideas. Wave-particle duality, indeterminacy, the nature of a quantized state of a system and the exclusion principle cause most conceptual problems and these are considered. The difficulties of teaching the subject are discussed. (UK)

27839 UNPERTURBED MEASUREMENTS OF THE N-QUANTUM STATE OF AN HARMONIC OSCILLATOR. Braginskii, V. B.; Vorontsov, Yu. I.; Krivchenkov, V. D. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 68: No. 1, 55-60(Jan 1975). (In Russian).

The principal conditions of virtually unperturbed measurement of the n-quantum state of an harmonic oscillator by means of an electron beam are analyzed. The limits of sensitivity of the measurements and the probability for oscillator perturbation are determined. (auth)

Quantum Field Theories

Refer also to abstracts 27152, 27179, 27186, 27187, 27209, 27363, 27403, and 27443.

27840 (AD-786643) ALMOST PAINLESS QUANTUM ELECTRODYNAMICS. Augenstein, B. W. (Rand Corp., Santa Monica, Calif. (USA)). Jan 1974. 17p. (P-5148). NTIS $3.25.

It is shown how the partial differential equations governing a centrally important segment of relativistic quantum electrodynamics—namely, radiative corrections introduced by the quantization of the electromagnetic radiation field—in its simpler aspects can be derived by novel and very elementary means. (auth)

27841 (CONF-720923-P2, pp 1-6) AXIOMATIC FIELD THEORY. Araki, H. (Kyoto Univ.). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The discussion of axiomatic field theory covers constructive field theory, the analyticity of n-point amplitudes on the mass shell, generalizations of the Pomeranchuk theorem, parametric dispersion representations, and scaling, light-cone singularities, and asymptotic behavior of the Jost–Lehmann–Dyson spectral function. (JFP)

27842 (CONF-720923-P2, pp 115-121) SHORT-DISTANCE BEHAVIOR OF QUANTUM ELECTRODYNAMICS AND AN EIGENVALUE CONDITION FOR α. Adler, S. L. (Inst. for Advanced Study, Princeton, NJ). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

Recent work on the short-distance behavior of quantum electrodynamics is reviewed, and in particular the question of whether the physical fine structure constant α can be calculated within the framework of quantum electrodynamics is discussed. It is concluded that by requiring the renormalization constants of electrodynamics to be finite, combined with loopwise summation, leads to an eigenvalue condition for α. It is conjectured that this is the mechanism which fixed the value of the fine structure constant. (JFP)

27843 (CONF-720923-P2, pp 169-173) FIELD THEORY IN LESS THAN FOUR DIMENSIONS; THE RENORMALIZATION GROUP. Wilson, K. G. (Cornell Univ., Ithaca, NY). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The review covers field theory in space–time dimension d between two and four and a reformulation of the renormalization group. (JFP)

27844 (CONF-720923-P2, pp 285-294) GAUGE THEORIES: ANOMALIES, REGULARIZATION, AND RENORMALIZATION. Zumino, B. (CERN, Geneva). 1972).

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

The discussion of gauge theories covers anomalies, regularization, renormalization, spontaneously broken gauge groups, the Weinberg–Salam model, and mass relations. (JFP)

27845 (CONF-720923-P2, pp 295-298) REGULARIZATION OF GAUGE FIELD THEORIES. Bardeen, W. A. (Stanford Univ., CA). 1972.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

In proceedings of the XVI international conference on high energy physics. Vol. 2.

It is found that it is possible to avoid new anomalies either in higher order or in the Yang–Mills structure which would destroy the renormalizability of these theories. It is concluded that if the theory is chosen as to avoid the anomalies of the free spinor loop then no further anomalies are present in the theory. The procedure is to devise a regularization scheme for the Feynman amplitudes which preserves the local gauge symmetry at every stage. The n-dimensional regularization scheme is intuitively pretty and simple to use in practical calculations. (JFP)

27846 (JINR-E2-8506) ON COHERENT STATES. 3. Classical Form of Quantum Field Theory Equations (Coherent State Representation). Polubarinov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 34p. Dep. NTIS (US Sales Only) $4.75.

A definition of the coherent state representation in quantum field theory and in quantum mechanics is given. In this representation quantum field theory equations achieve a form of classical field theory ones (with the inherent to the latter causality) not only in simple theories (free fields and interactions with an external current or field) but also in the general case of closed systems of interacting fields. Conversely, a classical field theory can be transformed into a form of quantum ones. (auth)

27847 (JINR-E4-7487) PERTURBATION THEORY FOR HAMILTONIANS OF ANDERSON AND HABBARD TYPE. II. Analog of General Statistical Wick Theorem for Diagonal Operators, Correlation Functions. Westwan'ski, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). INIS.

A formulation is given of the analogue of the generalized, statistical theorem of Wick for diagonal operators. The models of Anderson and Habbard are considered as an example of the use of perturbation theory presented here. (tr-SJR)

27848 (NBI-HE-74-17) EFFECTIVE COUPLING EXPANSION OF NON-ABELIAN GAUGE THEORIES. Olesen, P. (Niels Bohr Institutet, Copenhagen (Denmark)). Nov 1974. 36p. INIS.

Unrenormalized non-Abelian gauge theories are investigated using renormalization group methods. It is shown that the bare coupling $g_0(\Lambda,g)$ approaches the effective coupling for large values of the cutoff Λ. It is also shown that the unrenormalized propagator (and the 3- and 4-point vertices) approaches the bare propagator for large momenta. The way in which the renormalization group, for asymptotically free theories, can be understood in the case of large (spacelike) momenta as a perturbation expansion of the unrenormalized theory is discussed. The assumption that $\beta(g)$ has a second zero for $g = g_1 < \infty$ is investigated in this framework and is shown to lead to an inconsistency (the arguments are not rigorous). On the other hand, the assumption that the effective coupling approaches infinity at large distances does not lead to an inconsistency. It is therefore concluded that the effective coupling must become infinitely strong in the infrared region. (auth)

27849 (NP-20294-P2) SUMMER SCHOOL ON PARTICLE PHYSICS, GIF-SUR-YVETTE, FRANCE, 24 SEPTEMBER–6 OCTOBER 1973. Volume II. Field Theory. Brezin, E.; Iliopoulos, J.; Itzykson, C.; Stora, R. (Institut National de Physique Nucleaire et de Physique des Particules, 75–Paris (France)). 1973. 209p. (In French and English). Dep. NTIS (US Sales Only) $13.50.

There were four lectures included for which separate abstracts were prepared. (JFP)

For abstracts of individual lectures see: 27152, 27287, 27850, and 27851.

27850 (NP-20294-P2, pp vp Paper 1) FIELDS, LAGRANGIANS, SYMMETRIES. Itzykson, C. (CERN, Geneva). 1973. (In French).

In summer school on particle physics, Gif-sur-Yvette, France, 24 September–6 October 1973. Volume II.

The characteristics of Lagrangian mechanics are presented: Special attention is payed to symmetries, associated currents, and Abelian and non-Abelian gauge invariance in a classical context. (FR)

27851 (NP-20294-P2, pp vp Paper 3) LAGRANGIAN THEORY AT HIGHER ORDERS. Brezin, E. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

In summer school on particle physics, Gif-sur-Yvette, France, 24 September–6 October 1973. Volume II.

The following points are treated: Lagrangian of interaction, Feynman diagrams, characterization of divergences, regularization, renormalization at the order of a loop. (FR)

27852 (SLAC-179(Vol.2), pp 237-243) CLASSICAL FIELD EQUATIONS OF GAUGE THEORIES WITH CORRELATIONS BETWEEN COLOR AND SPACE ROTATIONS. Bars, I. (Stanford Univ., CA). Nov 1974.

From SLAC summer institute on particle physics; Stanford, California, USA (29 Jul 1974).

In proceedings of summer institute on particle physics, July 29–August 10, 1974. Volume II.

Some fairly recent ideas concerning the classical field equations of color gauge gluon–quark theories are presented, using an approach consisting of searching for classical field equations with self-consistent boundary conditions that make the solutions covariant under a combined internal symmetry transformation plus a space rotation. The work is an exploration of bound states of a given Hamiltonian that are related to hadrons. As an example an SU(2) gauge theory of color gluons interacting with a single massive antiquark is considered. (JFP)

27853 ABSENCE OF THE ANOMALOUS MAGNETIC MOMENT IN A SUPERSYMMETRIC ABELIAN GAUGE THEORY. Ferrara, S.; Remiddi, E. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 53: No. 4, 347-350(23 Dec 1974).

A general argument is given for the vanishing of the anomalous magnetic moment in a supersymmetric Abelian gauge theory recently constructed by Wess and Zumino, provided in such a model the appropriate Ward identities are consistent with renormalized perturbation theory. The conclusion is in fact confirmed by explicit one-loop calculation, thus providing a new example of cancellation of Feynman graphs in supersymmetric theories. (auth)

27854 REGGE BEHAVIOUR IN AN ASYMPTOTICALLY FREE FIELD THEORY. Cardy, J. L. (California Univ., Santa Barbara (USA). Dept. of Physics). Phys. Lett., B; 53: No. 4, 355-358 (23 Dec 1974).

The high-energy behavior at fixed momentum transfer of φ^3 theory in six dimensional space–time is considered as the simplest example of an exactly renormalizable asymptotically free theory. It is found that the damping in transverse momentum of the full theory is sufficiently strong to give rise to moving Regge pole singularities, in contrast to a fixed-point theory, which would naturally lead to a fixed square-root branch point. (auth)

27855 GRAPHICAL METHOD FOR FINDING POSSIBLE QUANTIZABLE FREE-FIELD THEORIES FOR HIGHER SPIN. Cox, W. (Liverpool Polytechnic). J. Phys., A (London); 7: No. 18, 2249-2257(11 Dec 1974).

Graphs associated with the Gel'fand-Yaglom equations for arbitrary spin are used in a simple method to find the number of conditions which a good quantizable free-field theory must satisfy. The number of conditions is seen to be simply related to the line independence numbers of the s block subgraphs of the theory. This provides a rough guide as to whether a particular theory is possibly quantizable. Some examples are given. Also a general result is given which enables quick elimination of a range of "bad" theories by visual examination of their graphs. (auth)

27856 FUNCTIONS OF THE FREE FIELD: EXAMPLES FOR ESSENTIALLY LOCAL NON-LOCALIZABLE FIELDS. Luecke, W. (Technische Univ., Clausthal, Ger.). J. Phys., A (London); 7: No. 18, 2258-2266(11 Dec 1974).

By extensive use of methods developed by Rieckers (Int. J. Theor. Phys.; 4: 55-82 (1971)) it is shown that power series of the free field, while not strictly localizable in general, are essentially local with respect to all those Gel'fand spaces S^α on which they can be defined at all. (auth)

27857 QUANTUM ELECTRODYNAMICS AND EXOTIC ATOMIC PHENOMENA OF HIGH Z-ELEMENTS. Brodsky, S. J. (Stanford Univ., CA). Comments At. Mol. Phys.; 4: No. 4, 109-118(Jul 1973).

A review is given of the physics of exotic atomic phenomena, especially positron autoionization, which can occur if the charge of the nucleus is increased beyond the critical value $Z \sim 170$. The adiabatic collision of two heavy ions can be used to study experimentally the problem of the Dirac electron in a Coulomb field beyond the critical value where pair production occurs. Various approaches to this phenomenon are discussed, including the possible complications of quantum electrodynamics corrections. A brief review of recent tests of quantum electrodynamics in high Z electronic and muonic atoms is also presented. 24 references. (auth)

27858 QUANTIZATION OF NON-LOCAL FIELD THEORY. Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Int. J. Theor. Phys.; 10: No. 1, 19-37(Jul 1974).

The scheme of quantisation of non-local field theory is formulated. An intermediate regularisation is introduced into the non-local Lagrangian of the classical scalar field in such a way that the procedure of the canonical quantisation leads to the appearance of additional ghost states with indefinite metrics. The ghost states disappear when the regularisation is removed but the propagator of the scalar particle becomes non-local and the S-matrix is finite, unitary, causal and covariant in each perturbation order. (auth)

27859 NONCAUSAL CHAINS. Borie, E.; Cadez, A. (Michigan State Univ., East Lansing). Gen. Relativity Gravitation; 5: No. 4, 467-473(Aug 1974).

The equivalence of the Feynman rules for gauge fields and the usual Feynman rules is demonstrated, by explicit calculation, for the special case of a scalar field with self-coupling. The result may be applicable to more general cases, such as the quantum theory of gravity. (auth)

27860 TOPOLOGY OF HIGGS FIELDS. Arafune, J. (Univ. of Chicago); Freund, P. G. O.; Goebel, C. J. J. Math. Phys. (N.Y.); 16: No. 2, 433-437(Feb 1975).

It is shown that the conserved magnetic charge discovered by 't Hooft in non-Abelian gauge theories with spontaneous symmetry breaking is not associated with the invariance of the action under a symmetry group. Rather, it is a topological characteristic of an isotriplet of Higgs fields in a three-dimensional space: the Brouwer degree of the mapping between a large sphere in configuration space and the unit sphere in field space provided by the normalized Higgs field $\hat{\phi}^a = \phi^a (\phi^b\phi^b)^{-\frac{1}{2}}$. The use of topological methods in determining magnetic charge configurations is outlined. A peculiar interplay between Dirac strings and zeros of the Higgs field under gauge transformations is pointed out. The monopole-antimonopole system is studied. (auth)

27861 REPRESENTATION THEORY OF THE UNIVERSAL COVERING OF THE EUCLIDEAN CONFORMAL GROUP AND CONFORMAL INVARIANT GREEN'S FUNCTIONS. Grensing, G. (Deutsches Elekronen-Synchrotron, Hamburg). J. Math. Phys. (N.Y.); 16: No. 2, 312-317(Feb 1975).

A special realization is presented for the universal covering of the Euclidean conformal group. This group can be defined as a transformation group on the Euclidean version of compactified Minkowski space such that the action on this space coincides with the usual one of the Euclidean conformal group. The representations of the principal and complementary series were constructed, and the intertwining kernels were derived for the equivalent representations. The connection between representation theory and conformal invariant quantum field theory is studied. To this end the reduction of the tensor product of two representations of the supplementary series was also given. (auth)

27862 ALGEBRAIC REPRESENTATION OF CONTINUOUS SUPERSELECTION RULES. Cirelli, R.; Gallone, F.; Gubbay, B. (Univ., Milan). J. Math. Phys. (N.Y.); 16: No. 2, 201-213(Feb 1975).

From the logic approach to quantum and classical mechanics, the W*-algebraic approach is deduced in dependence of a suitable "prestate." An algebraic representation of the logic description is in fact constructed in a framework in which continuous superselection rules can be present. Logic propositions, observables, and states are represented by decomposable projections, decomposable self-adjoint operators, and normal states in a direct integral of Hilbert spaces. In this representation each algebraic term becomes the representative of a homologous logic one and the expectation values as well as the superselection rules are conserved. When a principle of "undistinguishability" is taken into account, the representation is faithful. In the classical case, the representation results in Koopman's formalism. (auth)

27863 STOCHASTIC FIELD THEORY. Guerra, F. (Univ., Salerno, Italy). J. Phys. (Paris), Colloq.; No. 1, 95-98(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

A new method of quantization of classical canonical systems based on the theory of Markov processes has been introduced by Nelson a few years ago. The basic ideas of stochastic quantization extending Nelson original method to dynamical systems are presented and stochastic field theory is introduced. It is shown that there exists a strong connection between this stochastic field theory and Euclidean field theory. (FR)

27864 CONFORMAL INVARIANT QUANTUM FIELD THEORY. Mack, G. (Univ., Bern). J. Phys. (Paris), Colloq.; No. 1, 99-106 (1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The construction and properties of a nontrivial exactly conformal invariant quantum field theory are investigated, using nonperturbation techniques. The following points are reviewed: dilatation and conformal invariance, fixed points and asymptotic limits, skeleton graph theory, conformal partial wave expansion, solution of integral equations, tensor fields, operator product expansion, and crossing symmetry, and duality. (FR)

27865 SECOND QUANTIZATION AND INTERACTION OF ELECTROMAGNETIC FIELDS FOR NONZERO MASS SYSTEM IN ANGULAR MOMENTUM BASIS. II. Parkash, O.; Singh, B.; Rajput, B. S. (Kurukshetra Univ., India). Indian J. Phys.; 48: No. 6, 509-519(Jun 1974).

The study of interaction and second quantization of electromagnetic fields for non-zero mass system has been undertaken in angular momentum basis and the selection rules for emission and absorption of a massive particle are derived. Reduction of real transverse electromagnetic vector potential for non-zero mass system has been derived in terms of irreducible representations of proper, ortho-chronous, inhomogeneous Lorentz group in angular momentum basis. (auth)

27866 ASYMPTOTIC FREEDOM IN FIELD THEORY. Crewther, R. J. (National Accelerator Lab., Batavia, IL). J. Phys. (Paris), Colloq.; No. 1, 111-115(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Some recent work on the renormalization group is described, particular emphasis being given to the discovery of Politzer, and Gross-Wilczek, that gauge theories are asymptotically free. (FR)

27867 NEW TRENDS IN FIELD THEORY. Symanzik, K. (Deutsches Elektronen-Synchrotron, Hamburg). J. Phys. (Paris), Colloq.; No. 1, 117-126(1973).

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The following problems are treated: constructive field theory, technical advances in renormalization theory, exploiting the renormalization group, conformal invariance, superpropagators, and parastatistics. (FR)

27868 DERIVATION OF THE EFFECTIVE POTENTIAL. Fukuda, R.; Kyriakopoulos, E. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 85: No. 2, 354-364(27 Jan 1975).

A simple derivation of the effective potential for single and composite operators is given. Green functions under general constraints are considered and compact expressions for derivatives of the effective potential are given. (auth)

27869 ON THE ALGEBRAIC CONSISTENCY CONDITIONS IN CANONICAL $\lambda\Phi^4$ THEORY. Lukierski, J.; Rytel, L. (Wroclaw Univ. (Poland). Instytut Fyziki Teoretycznej). Nucl. Phys., B; 85: No. 2, 311-316(27 Jan 1975).

The algebraic consistency requirements for the short distance behavior of the operator product expansions $\Phi\Phi$, ΦJ and JJ where $(\Box - m^2)\Phi = \lambda J$, and J is local and trilinear ($\lambda\Phi^4$ theory) are studied. It is shown that in four dimensions (D = 4) under the assumption of a canonical scheme "naive" Wilson expansions, abstracted from the short-distance behavior of the products of free Wick powers, cannot be used. The inconsistency is also studied in an arbitrary and continuous number of dimensions and it disappears for D < 4. (auth)

27870 DEGREE OF DIVERGENCE OF FEYNMAN DIAGRAMS IN SUPERFIELD THEORIES. Capper, D. M.; Leibbrandt, G. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 85: No. 2, 492-502(27 Jan 1975).

General Feynman graphs called "supergraphs" are considered in the context of a cubic superfield interaction. A formula, valid to all orders of perturbation theory, is derived for the superficial degree of divergence of any such supergraph. It is shown that only (+-) self-energy graphs are primitively divergent and that there are neither overlapping divergences nor divergent vertex diagrams in the theory. (auth)

27871 SUPERSYMMETRIC LANGRANGIAN POSSESSING INTERNAL SU(2) SYMMETRY. Capper, D. M. (Imperial Coll. of Science and Technology, London (UK)); Leibbrandt, G. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 85: No. 2, 503-516(27 Jan 1975).

A supergauge invariant Lagrangian, containing an internal SU(2) symmetry is constructed. The Lagrangian is shown to be free of ghosts and tachyons but is unfortunately unrenormalizable, although the infinities are much less virilent than might be expected. (auth)

27872 SUMMED ANALYTIC RENORMALIZATION. Collop, D. J. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). Nucl. Phys., B; 85: No. 2, 415-428 (27 Jan 1975).

With a small modification, analytic renormalization is shown to be multiplicative and the renormalization group equation is derived. For quantum electrodynamics the method is compatible with gauge invariance at the one-loop level. (auth)

27873 FIELD THEORY OF THE INTERACTING STRING: THE CLOSED STRING. Marshall, C.; Ramond, P. (Yale Univ., New Haven, Conn. (USA). Dept. of Physics). Nucl. Phys., B; 85: No. 2, 375-414(27 Jan 1975).

Dual models are recast in the language of a quantum field theory of functional fields, restricting the discussion for simplicity to the closed string model. The dynamics for both scalar and spinor functional fields are derived from a unique parametrization invariant action. Passages to the Hamiltonian formalism and second quantization are explicitly worked out for the closed mesonic string in the front form. The results are equivalent to those obtained earlier by GGRT, i.e. no ghost fields at the price of an anomalous number of space-time dimensions and a tachyon. Finally, the parametrization invariance requirement is used on the action to derive couplings of closed strings to local fields by extending a global U(1) invariance built in the free action into a local one in the functional sense. The self-couplings of closed string fields are constructed by requiring these to be consistent with the gauge invariance of the external fields. This procedure uniquely leads (for the open string) to the string splitting picture of Nambu and Mandelstam. The closed string is found to cross itself and then split up into two others. Both open and closed strings have quartic interactions corresponding to strand (for the open string) and lobe (for the closed string) exchanges. The case of the interacting fermionic model is not treated here. (auth)

27874 IS THE HIGGS-KIBBLE MECHANISM NECESSARY FOR UNIFIED GAUGE THEORIES. Sucher, J. (Univ. of Maryland, College Park). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 142-157(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

The discussion of the Higgs-Kibble mechanism for unified gauge theories includes trees and single loops and life at the two-loop level: the imaginary part. (JFP)

27875 QUANTUM ELECTRODYNAMICS AND RADIATION REACTION. Eberly, J. H. (Univ. of Rochester, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 344-355(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Some problems in nonrelativistic QED are discussed from the point of view of the radiation reaction. Recent attempts to use the conceptual simplicity of the Heisenberg picture to discuss such problems as the Lamb shift, the ac Stark effect, the electron's g-factor anomaly, and the point electron self mass are described. Questions of operator ordering, a Markovian approximation, and interpretive problems are mentioned. (auth)

27876 QUANTUM FIELD THEORY IN CURVED SPACE. DeWitt, B. S. (Univ. of Texas, Austin). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 23, 660-688(1975).

From meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974). See CONF-740933-.

Quantum field theory is described in the following non-Minkowskian settings: Incomplete spaces (half-spaces, slab spaces), spaces with moving boundaries, curved spaces (black holes). The problems of defining the stress tensor, and, in particular, its vacuum expectation value in these settings are discussed. The vacuum stress tensor is computed for the Casimir effect and is used in the computation of particle production by black holes. Hawking's results are described, in which both a temperature and an entropy are assigned to every black hole. (auth)

27877 RENORMALIZATION OF GAUGE-INVARIANT THEORIES. Slavnov, A.A. (Steklov Mathematics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Part. Nucl. 5: No. 3, 303-317 (Jan 1975).

A renormalization procedure is considered for gauge-invariant theories. Theories with spontaneously broken symmetry are analyzed in detail. (auth)

27878 MULTIPOLE EXPANSION IN CLASSICAL AND QUANTUM FIELD THEORY AND RADIATION. Dubovik, V.M.; Cheshkov, A.A. (Theoretical Physics Laboratory, JINR, Dubna). Sov. J. Part. Nucl. 5: No. 3, 318-337 (Jan 1975).

We analyze the properties of a new multipole family of current (toroid) moments, which differ from the charge and magnetic moments.

The principal effects and conceptual changes resulting from the existence of these moments are indicated. A complete formalism is presented for multipole expansions (current parametrization) in classical and quantum field theory. (auth)

27879 SPECTRUM OF STATES IN THE ONE–DIMENSIONAL t'HOOFT MODEL. Marinov, M.S.; Perelomov, A.M.; Terent'ev, M.V. (Institute of Theoretical and Experimental Physics). JETP Lett. 20: No. 7, 225-226 (5 Oct 1974).

We consider the theory of spinor and vector fields in two–dimensional space–time; this theory is invariant with respect to the internal symmetry group SU(N). The interaction is of the Yang–Mills type. The model can be solved in the limit as $e^2 \sim N^{-1} \to 0$ (e is the coupling constant). The mass spectrum of the fermion–antifermion system, previously obtained by t'Hooft by summing a certain class of Feynman diagrams, is obtained. (auth)

27880 ASYMPTOTIC BEHAVIOR OF FORM FACTORS IN A CLASS OF FIELD THEORIES. Shei, S. (Rockefeller University, New York, New York 10021). Phys. Rev. D 11: No. 1, 164-173 (1 Jan 1975).

It is shown that for all renormalizable field theories, excluding gluon and gauge theories, the asymptotic behaviors of the on–mass–shell form factors are related to the short–distance behaviors of the theories. In particular, if the Gell–Mann–Low eigenvalue conditions are satisfied, the asymptotic behavior of the on–mass–shell electromagnetic form factor is $(m^2/-q^2)^\gamma$, where γ is the anomalous dimension of the proton field. We also show that the form factor of the axial–vector current has the same asymptotic behavior as that of the vector current. (auth)

27881 A GRAVITY-MODIFIED PHOTON PROPAGATOR. Klein, U. (Hochschule fuer Sozial- und Wirtschaftswissenschaften, Linz (Austria). Inst. fuer Physik). Z. Phys.; 271: No. 1, 17-20(Nov 1974). (In German).

Part of a thesis.

In the framework of gravity-modified quantum electrodynamics due to Salam et al. the effect of gravitation on electron–electron scattering is expressed by a modification $D(k^2)$ of the photon propagator. A plausible gravity-modified Coulomb potential is derived from the behavior of $D(k^2)$ in the limiting case of large spacelike momentum transfer. (auth)

27882 QUANTIZATION OF FREE BOSON FIELDS OF ARBITRARY SPIN (M NOT EQUAL TO 0). Samokhin, A. P.; Slavnov, D. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 5, 553-562(1974). (In Russian).

The canonical quantization of fields with $m \neq 0$ with arbitrary integral spins was carried out. Formulas were obtained for the commutation relation of the field with any arbitrary spins, correcting the corresponding formulas of Fierz. (tr-auth)

27883 BUBBLES IN METASTABLE VACUUM. Voloshin, M. B.; Kobzarev, I. Yu.; Okun, L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 6, 1229-1234(Dec 1964). (In Russian).

A possible existence of the bilayer vacuum is discussed. It is shown that the upper vacuum can be practically stable against the spontaneous transition to the lower vacuum even if the coupling is strong. Various mechanisms of production of bubbles of the lower vacuum and the classical growth of bubbles are considered. (3 figures) (auth)

27884 MODEL CALCULATION OF THE VACUUM ENERGY DENSITY FOR A SELF-COUPLED BOSE FIELD. Pittner, L.; Streit, L. (Univ., Graz). Acta Phys. Austr.; 38: No. 4, 361-366 (1973).

The ground state energy density of the $(\phi^2)_{s+1}$ theories is calculated as a function of mass and coupling constant in the limit as the spatial cut-off is removed. (auth)

27885 PATH-INTEGRAL SOLUTION OF THE STATIC ULTRA-LOCAL $G\phi^4$-THEORY OF CAIANIELLO AND SCARPETTA. Kainz, W. (Technische Hochschule, Vienna). Lett. Nuovo Cim.; 12: No. 7, 217-220(15 Feb 1975).

A previous result for the static ultra-local approximation of $g\phi^4$ quantum field theory obtained by approximating the free propagator is rederived by solving the path integral for the propagator. It is shown that the path integral is indeed not only just a compact notation for perturbation theory, but the solution of the field theoretic problem in closed form. Also this example gives some insight into how the divergencies of perturbation theory result automatically from the path integral. In this approximation it is shown that the divergencies of perturbation theory do not sum up to a finite result, but that they are an intrinsic property of the continuity of space–time. By assuming a grained structure of space–time with the minimal length $1/M > 0$, there are no divergencies in this approximation. (JFP)

27886 PROTOTYPE NON-ABELIAN GAUGE FIELD THEORY, MONOPOLES, AND STRINGS. Venturi, G. (Univ., Bologna). Lett. Nuovo Cim.; 12: No. 8, 257-260(22 Feb 1975).

The effect of the introduction of two magnetic charges of opposite sign in a prototype non-Abelian gauge field theory is examined. This theory consists of two massive gauge theories coupled through a minimal-type coupling. (JFP)

27887 PROPOSED EXPERIMENT ON ABSORBER THEORY. Heron, M. L.; Pegg, D. T. (James Cook Univ. of North Queensland, Townsville, Australia). J. Phys., A (London); 7: No. 15, 1965-1969(11 Oct 1974).

As distinct from conventional electrodynamics in which the advanced potential solution of Maxwell's equations is rejected on causal grounds, absorber theory allows the possibility of a mixture of advanced and retarded radiation, dependent on cosmological boundary conditions. In a recent experiment Partridge (Nature, Lond.; 244: 263 (1973)) attempted to detect advanced effects by introducing a local absorber, but it was maintained by Pegg (Nat. Phys. Sci.; 246: 40 (1973)) that, because a static absorber was used, only a null result was possible. The theory and a brief outline of an experiment is given which uses a time-asymmetric chopper absorber to alter the boundary conditions and thus the ratio of the advanced to retarded components in the mixture, provided this is nonzero initially, leading to possibly detectable effects. (auth)

27888 CONFORMAL INVARIANCE AND ACTION-AT-A-DISTANCE ELECTRODYNAMICS. Ryder, L. H. (Univ., Karlsruhe, Ger.). J. Phys., A (London); 7: No. 15, 1817-1828(11 Oct 1974).

The Fokker-Wheeler-Feynman theory of action-at-a-distance electrodynamics is not conformally invariant. It is shown how to modify it to restore conformal invariance, and it is proved that the modified theory yields Maxwell's equations and gives Dirac's expression for the radiation reaction. (auth)

27889 NOTE ON THE CLASSICAL THEORY OF TACHYONS. Strnad, J.; Kodre, A. (Univ. of Ljubljana, Yugoslavia). Lett. Nuovo Cim.; 12: No. 8, 261-262(22 Feb 1975).

Some considerations are given showing that certain aspects of signal transmission were so far omitted from the classical theory of tachyons. (JFP)

27890 ELECTRON STATES IN A FINITE CHAIN OF DELTA-FUNCTION POTENTIALS. Karaivanov, V. D. (Univ., Sofia). Lett. Nuovo Cim.; 12: No. 8, 266-268(22 Feb 1975).

A potential field is considered which is a finite one-dimensional chain or lattice of various delta functions, the field being zero in all points except the sites. (JFP)

27891 ANOMALOUS DIMENSIONS IN THE THIRRING MODEL. Deo, B. B.; Kumar, S. (Utkal Univ., Orissa, India). Indian J. Phys.; 48: No. 7, 615-633(Jul 1974).

The dimensions of a self-interacting spinor field in the Thirring model is calculated exactly using formal methods of quantum field theory. It is shown that there are two categories of solutions, scattering type and stationary type for the model and one of them agrees with the results of Johnson. It is also found that for a possible renormalized version of the theory, the dimension may become complex leading to nonhermitian Green's functions. (auth)

Gravitation and General Relativity

Refer also to abstracts 27252, 27268, 27406, and 27464.

27892 (JINR-P2-7558) COSMOLOGICAL EQUATIONS AND SCALAR FIELD WITH SOURCES. Asanov, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 8p. (In Russian). INIS.

An exact solution is obtained of the Einstein equations having a cosmological constant. This solution corresponds to a spherically symmetrical statistical distribution (of limited size, $r > 3$ km/c^2) of a dustlike substance without pressure with sources of a scalar, massless field and with the same field within the substance. Outside the substance there is only a gravitational field. There are no details for the internal solution. (tr-SJR)

27893 (KFKI-74-76) TWISTOR VARIABLES OF RELATIVISTIC MECHANICS. Perjes, Z. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Nov 1974. 30p. Dep. NTIS (US Sales Only) $4.50.

The description of noninteracting dynamical systems in Penrose's twistor theory is described. One begins with an introduction to the formal treatment of massive systems based on the use of the angular momentum twistor $A^{\alpha\beta}$. Expressions for dynamical data in terms of $A^{\alpha\beta}$ are given. It is shown that the internal symmetry transformations involved in the parametrization of $A^{\alpha\beta}$ by

one-index twistors are of the canonical type. The case of two supporting twistors is discussed in detail. Relative to the frame of these twistors, a rest-frame of the dynamical system, the classical spin has the remarkable structure $s = \bar{\psi}\sigma\psi$. When decomposing $A^{\alpha\beta}$ into three twistors, the minimal symmetry transformations define a 14-parameter group. It is shown that this group of symmetry is locally isomorphic to the inhomogeneous SU_3. (auth)

27894 TWO-COMPONENT NEUTRINO FIELD AND SPHERICAL SYMMETRY IN A SPACE–TIME WITH CURVATURE AND TORSION. Kuchowicz, B. (Warsaw Univ. (Poland)). Phys. Lett., A; 50: No. 4, 267-268(11 Dec 1974).

The incompatibility of the spherical symmetry of a space–time with the presence of a "classical," i.e. not-quantized, 2-component neutrino field is extended from the purely Riemannian to the Riemann–Cartan geometry, corresponding to a space–time with curvature and torsion. (auth)

27895 AMBIPOLAR DIFFUSION IN THE GRAVITATIONAL FIELD. Khantadze, A. G.; Chekhoshvili, B. Ya. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 76: No. 3, 609-612(Dec 1974). (In Russian).

The solution of a nonstationary diffusion equation of charged particles is found in the presence of recombination and ion production. The initial distribution is given in the form of a Chapman function. The obtained solution describes complete dispersion of the initial distribution and the establishment of a regular distribution of the main maximum in the ionospheric F region. (auth)

27896 COMPLETION OF A CHRONOLOGICAL SPACE. Woodhouse, N. M. J. (King's Coll., London). Proc. Cambridge Phil. Soc.; 76: 531-544(Nov 1974).

The problem of completing the mathematical structures abstracted from the time ordering of the events in the space-times of general relativity is motivated and solved. The new construction is compared with that of Geroch, Kronheimer and Penrose (Proc. Roy. Soc. Ser. A.; 327: 545 (1972)). (auth)

27897 UNIQUENESS OF THE EINSTEIN–MAXWELL FIELD EQUATIONS. Lovelock, D. (Univ. of Waterloo, Ont.). Gen. Relativity Gravitation; 5: No. 4, 399-408(Aug 1974).

The most general Lagrange density (which is a concomitant of the metric tensor together with a vector field and its first derivatives) for which the associated Euler-Lagrange equations are precisely Maxwell's equations is obtained. Although it is more general than the Lagrangian which is commonly used, it still has essentially the same energy momentum tensor. (auth)

27898 QUATERNION WAVE EQUATIONS IN CURVED SPACE-TIME. Edmonds, J. D. Jr. (National Aeronautics and Space Administration, Moffett Field, CA). Int. J. Theor. Phys.; 10: No. 2, 115-122(Jul 1974).

The quaternion formulation of relativistic quantum theory is extended to include curvi-linear coordinates and curved space-time. This provides a promising framework for further exploration of a unified quantum/gravity theory. (auth)

27899 PHYSICAL QUANTITIES IN A CLASSICAL TWO-TENSOR THEORY OF GRAVITATION. Chela-Flores, J. (International Centre for Theoretical Physics, Trieste, Italy). Int. J. Theor. Phys.; 10: No. 2, 103-114(Jul 1974).

The energy content inside a three-dimensional sphere surrounding a point mass, which is taken to be the source of the short-range tensor field coupled to the long-range gravitational field through the equations of motion of the f-g theory is computed. (auth)

27900 ELECTROMAGNETIC ENERGY MOMENTUM TENSOR AND ITS UNIQUENESS. Lovelock, D. (Univ. of Waterloo, Ont.). Int. J. Theor. Phys.; 10: No. 1, 59-65(Jul 1974).

The uniqueness of the electromagnetic energy momentum tensor is established under general conditions. (auth)

27901 ALGEBRAICALLY SPECIAL FLUID SPACE-TIMES WITH HYPERSURFACE-ORTHOGONAL SHEARFREE RAYS. Wainwright, J. (Univ. of Waterloo, Ont.). Int. J. Theor. Phys.; 10: No. 1, 39-58(Jul 1974).

The Einstein field equations are solved subject to the assumptions that (1) the source of the gravitational field is a non-rotating perfect fluid, (2) the Weyl tensor is algebraically special, (3) the repeated principal null direction is tangent to a geodesic, shear-free and twistfree congruence, and is parallely transferred along the fluid congruence. The solutions in which the line-element admits a multiply transitive group of motions have been studied by Stewart and Ellis (J. Math. Phys.; 9: 1072 (1968)); the remaining ones are new, and appear to represent inhomogeneous anisotropic cosmological models. (auth)

27902 FOCUSING OF GRAVITATIONAL RADIATION. Ohanian, H. C. (Rensselaer Polytechnic Inst., Troy, NY). Int. J. Theor. Phys.; 9: No. 6, 425-437(Jun 1974).

The gain in intensity that can be achieved by using a massive object as a "lens" to focus gravitational radiation incident on the object from a point-like source is investigated. An object of mass M produces a gain in intensity of the order of $\alpha GM/\lambda c^2$ where α is a numerical factor which depends on the mass distribution and λ is the wavelength of the radiation. For large mass, the gain is large, but occurs only in a beam of small angular width. (auth)

27903 APPLICATION OF HIGHER RANK SPINORS IN GENERAL RELATIVITY. Tchrakian, D. H. (Saint Patrick's Coll., Maynooth, Ireland). Gen. Relativity Gravitation; 5: No. 3, 331-343(Jun 1974).

The formulation of two component spinors in the context of general relativity has been extended to (2j + 1)-component spinors $j = 0, \frac{1}{2}, 1, \frac{3}{2}, \ldots$ which includes the decomposition of the Riemann tensor into Petrov types, covariant differentiation and generalized spin coefficients. The formalism is developed along parallel lines with that of quantized fields. (auth)

27904 ELECTROMAGNETIC AND GRAVITATIONAL WAVES IN GENERAL RELATIVITY. I. Roy, S. R.; Tripathi, V. N. (Banaras Hindu Univ., India). Gen. Relativity Gravitation; 5: No. 3, 257-274(Jun 1974).

The external field of a bounded source emitting electromagnetic and gravitational radiation is considered. The field is assumed to be axially symmetric as well as reflexion symmetric and that it tends to flatness at infinity. The form of the electromagnetic tensor which is in accordance with the classical harmonic electric dipole radiation is assumed. It is shown that the whole set of field equations falls into seven "main equations" together with three supplementary conditions. These field equations are solved by multipole expansion method and the corresponding Initial Value Problem are discussed. (auth)

27905 GENERAL RELATIVITY AND GAUGE THEORIES. Carmeli, M. (Ben-Gurion of the Negev, Beersheba, Israel). Gen. Relativity Gravitation; 5: No. 3, 287-330(Jun 1974).

The theory of general relativity is presented in the form of a gauge field theory by use of the group SL(2,C). The following topics are discussed: (1) Spinor representation of the group SL(2,C); (2) Connection between spinors and tensors; (3) Maxwell, Weyl and Riemann Spinors; (4) Classification of Maxwell spinor; (5) Classification of Weyl spinor; (6) Isotopic spin and gauge fields; (7) Lorentz invariance and the gravitational field; (8) SL(2,C) invariance and the gravitational field; (9) Gravitational field equations. (auth)

27906 INTERACTING ELECTROMAGNETIC SHOCK WAVES IN GENERAL RELATIVITY. Bell, P.; Szekeres, P. (Univ. of Adelaide, Australia). Gen. Relativity Gravitation; 5: No. 3, 275-286(Jun 1974).

It is shown that the continuity conditions of Lichnerowicz (Theories relativistes de la Gravitation et de l'Electromagnetisme. Masson. (1955)) must generally be relaxed in favour of the O'Brien-Synge (Proc. Dublin Inst. Adv. Stud.; A9: (1952)) conditions in the case of shock electromagnetic waves. This is in particular true when two electromagnetic shock waves are in collision. Gravitational impulse waves are produced as a result of the weakened conditions. An exact solution exhibiting this behaviour is derived, and the effect of the impulse waves on a measuring device are compared with experimental results of Weber (Phys. Rev. Lett.; 22: 1320 (1969)). (auth)

27907 CONSTANCY OF THE LOCAL VELOCITY OF LIGHT IN GENERAL RELATIVISTIC GRAVITATIONAL FIELDS. Horedti, G. (Cluj Univ.). Gen. Relativity Gravitation; 5: No. 4, 475-477 (Aug 1974).

Using the natural, real units (proper time and proper length) for the definition of the spatial velocity, it is shown that the velocity of light during its propagation through gravitational fields is constant and exactly equal to its value in vacuum. Therefore, according to general relativity, it is not correct to speak about a variable velocity of light in gravitational fields. (auth)

27908 GENERATION OF NEW METRICS CONTAINING ARBITRARY FUNCTIONS. Pechlaner, E.; Das, A. (Simon Fraser Univ., Burnaby, B. C.). Gen. Relativity Gravitation; 5: No. 4, 459-465(Aug 1974).

Simple methods are presented by which certain solutions of the Einstein vacuum equation (and some other equations) can be used to generate further solutions of these equations. In some cases the new solutions admit a smaller number of metric automorphisms than the original ones and are, in this sense, more general. (auth)

27909 QUANTUM GRAVIDYNAMICS. II. Path Integrals with Spin. Clutton-Brock, M. (Newcastle Upon Tyne Univ., Eng.). J. Phys., A (London); 8: No. 1, 29-35(Jan 1975).

Spin-operators in a path integral can be collected into a path operator, which appears quite separate from the action and outside the exponential. In this way the problem of non-commuting operators inside the exponential is avoided. In curved space-time spinor matrices in the path operator must be referred to different frames at different points along the path. The components of the spinor matrices referred to different frames must be connected by means of the spinor parallel propagator. (auth)

27910 ALINEMENT OF FRAMES OF REFERENCE AT NULL INFINITY FOR ASYMPTOTICALLY FLAT EINSTEIN–MAXWELL MANIFOLDS. Bramson, B. D. (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A; 341: No. 1627, 451-461(14 Jan 1975).

It is shown that the asymptotic twistor equation leads to the asymptotic alinement of frames of reference. In the absence of gravitational radiation, this alinement reduces to a parallel one. (auth)

27911 QUANTUM GRAVIDYNAMICS. III. Error Estimates and Perturbation Expansions. Clutton-Brock, M. (Newcastle Upon Tyne Univ., Eng.). J. Phys., A (London); 8: No. 1, 36-45 (Jan 1975).

The error of a kernel is expressed as an integral equation involving its error generator, which is obtained from the appropriate wave equation. An iterative solution of the integral equation leads to a perturbation expansion. The relative errors of the covariant kernels derived in parts I and II (Clutton-Brock, J. Phys. A. Math. Gen.; 8: 16-28 and 29-35 (1975)) are shown to be of second order in the interval, which is necessary if the kernels are to be used in path integrals. Expressions for the error generators are derived. They involve the covariant derivatives of the world function and the spinor parallel propagator, exact expressions for which are given in an appendix. (auth)

27912 DOES A GRAVITATIONAL RED SHIFT NECESSARILY IMPLY SPACE–TIME CURVATURE?. Marsh, G.E. (University of Chicago, Chicago, Illinois 60637); Nissim-Sabat, C. Am. J. Phys. 43: No. 3, 266-267 (Mar 1975).

Schild has proposed a heuristic argument which attempts to show that any gravitational red shift requires that the geometry of space–time be curved. It is our intention to show that this argument is fallacious, and we believe that no argument which attempts to infer space–time curvature solely from the gravitational red shift can be valid. (AIP)

27913 YANG'S GRAVITATIONAL FIELD EQUATIONS. Thompson, A.H. (Department of Mathematics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. Lett. 34: No. 8, 507-508 (24 Feb 1975).

I examine the field equations for the gravitational field *in vacuo* recently proposed by Yang. Similarities with the orthodox theory are pointed out, but the equations appear to afford several "unphysical" solutions which will require investigation. (auth)

27914 NEW TYPES OF SINGULARITY IN GENERAL RELATIVITY. The General Cylindrically Symmetric Stationary Dust Solution. King, A. R. (University Coll., London (UK). Dept. of Mathematics). Commun. Math. Phys.; 38: No. 2, 157-171 (Oct 1974).

The general solution of Einstein's equations for a stationary, cylindrically symmetric distribution of pressure-free matter is obtained. It contains a function which may be freely prescribed. Through use of this freedom examples are given of new types of singularity in General Relativity. (auth)

27915 FARADAY TRANSPORT IN A CURVED SPACE–TIME. Madore, J. (Paris-6 Univ., 75 (France). Inst. Henri Poincare). Commun. Math. Phys.; 38: No. 2, 103-110(Oct 1974).

4 refs.

A covariant expression is given for the Faraday transport of electromagnetic radiation in a curved space–time. (auth)

27916 A CLASS OF ENERGETICALLY RIGID GRAVITATIONAL FIELDS. Goenner, H. (Goettingen Univ. (F.R. Germany). Inst. fuer Theoretische Physik). Z. Naturforsch., a; 29: No. 11, 1527-1530(Nov 1974).

12 refs.

In Einstein's theory, the physics of gravitational fields is reflected by the geometry of the curved space–time manifold. One of the methods for a study of the geometrical properties of space–time consists in regarding it, locally, as embedded in a higher-dimensional flat space. In this paper, metrices admitting a 3-parameter group of motion are considered which form a generalization of spherically symmetric gravitational fields. A subclass of such metrics can be embedded into a five-dimensional flat space. It is shown that the second fundamental form governing the embedding can be expressed entirely by the energy–momentum tensor of matter and the cosmological constant. Such gravitational fields are called energetically rigid. As an application, gravitating perfect fluids are discussed. (auth)

27917 SOME THEOREMS OF PROBE PARTICLE DYNAMICS IN THE RELATIVITY THEORY. Singatullin, R. S. (Bashkir State Univ., Ufa, USSR). Dokl. Akad. Nauk SSSR; 219: No. 4, 848-850(1 Dec 1974). (In Russian).

Two theorems on the dynamics of probe particles were proven. With these theorems the study and interpretation of point dynamics in some classes of electromagnetic and gravitational fields can be improved. The examination of the Riemann multifold V_4 is mathematically formulated. (JSR)

27918 MOVEMENT OF SPINLESS TEST PARTICLES IN SPACE–TIME WITH TORSION. Ponomarev, V. N. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 5, 541-547(1974). (In Russian).

The problem of the geodesic lines of a spinless test particle in space-time with torsion was studied. It was indicated that the torsion tensor can affect the geodesic line equations. From a comparison of the results obtained with experimental data on the classical effects of the general theory of relativity, the upper limit for the components of the torsion tensor was obtained. (tr-auth)

27919 X^4-INVARIANT 5-DIMENSIONAL GRAVITATIONAL THEORY. Aliev, B. G.; Vladimirov, Yu. S.; Nedopekin, V. S. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 71-76(1974). (In Russian).

A 5-dimensional theory of gravitation was previously studied in which the separation of the five coordinates was achieved by methods analogous to the Zel-manov method of chromometric invariants. It is shown that the same results can be obtained by the selection of quite inherent conditions if the 5-dimensional gravitational theory is constructed by separation of the five coordinates by methods analogous to the kinemetric invariant method. (JSR)

27920 SINGULARITIES IN SOLUTIONS OF THE EINSTEIN EQUATION FOR A STATIC SPHERICALLY SYMMETRIC FIELD. Pugachev, Ya. I.; Gun'ko, V. D. (Kuban State Univ., Krasnodar, USSR). Izv. Vyssh. Uched. Zaved., Fiz.; No. 10, 46-50(1974). (In Russian).

The character of the singularities in solutions of the Einstein equation for static spherically symmetric fields was investigated as a function of the selection of the supplementary conditions. It was shown that the primary singularity, the Schwarzschild sphere, can be created or established by means of one or another of the conditions without change of the physical premises and those of the gravitation equation. Different solutions, equivalent from the point of view of the observer, were obtained since the theoretical variations of the astronomical effects are far from the limits of experimental possibility. (tr-auth)

27921 TIME AND MASS IN RELATIVITY. Schoenberg, M. Acta Phys. Austr.; 38: No. 2, 168-196(1973).

The particle dynamics in the world-manifold is taken as the foundation of the world-geometry, in a Hamiltonian formalism with a scalar mass Hamiltonian, not involving the value of the mass. The Riemannian metric is obtained from the linear relation between the covariant and contravariant vectors of the mechanical momentum of a particle involved in the formalism. The basic differential equations for the world-lines of the particles allow one to define a new kind of parameter called the duration, with the same dimension as the Einstein gravitational constant. The proper-time parameter is defined in terms of the duration and mass Hamiltonian, before the introduction of the Riemannian metric. The metric tensor g(x) comes in as a mechanical field related to the inertial properties of the particles, which determines the mass Hamiltonian of the free particles. The symmetry of g(x) is a consequence of the mass Hamiltonian formalism. The classical Hamiltonian formalism is naturally related to the wave equations of the relativistic quantum mechanics, and leads to a generalization of those wave equations. (auth)

27922 FORMULATION OF LINEARISED GRAVITY. Tchrakian, D. H. (Saint Patrick's Coll., Maynooth, Ireland). Gen. Relativity Gravitation; 5: No. 4, 379-386(Aug 1974).

The formulation of linearised gravity in terms of the "electric" and "magnetic" gravitational fields is extended to take into account the presence of matter. The modes of radiation, the equations of motion and the potential in the static case are given. The relevant components of the super–energy tensor are calculated and a quantity named the superforce is introduced. (auth)

27923 CRITERION FOR THE STABILITY OF A CHARGED SPHERE IN GENERAL RELATIVITY. Omote, M.; Sato, H.

(Tokyo Univ. of Education). Gen. Relativity Gravitation; 5: No. 4, 387-397(Aug 1974).

A criterion for stability of a charged sphere is obtained by use of two different methods. The result is applied to a charged dust in order to investigate its stability. (auth)

27924 NOTE ON THE ANGULAR MOMENTUM OF AXISYMMETRIC ISOLATED RADIATIVE SYSTEMS. d'Inverno, R. A.; Russell-Clark, R. A. (Univ. of Southampton, Eng.). J. Phys., A (London); 8: No. 1, 6-15(Jan 1975).

The Landau-Lifschitz pseudotensor (Landau, L. D. and Lifschitz, E. M. The Classical Theory of Fields (Oxford. Pergamon. 1962)) is used to calculate the total angular momentum of an isolated radiative system in the full (axially symmetric) gravitational theory. The result differs from that derived from the Tamburino and Winicour definition of angular momentum (Phys. Rev.; 150: 1089-53 (1966)), which is not based on a pseudotensor and which leads to a constant component of angular momentum about the symmetry axis. It is shown that the results cannot be brought into agreement by performing a BMS transformation. (auth)

27925 NON-RELATIVISTIC LIMIT OF STATIONARY TWO-VARIABLE SOLUTIONS OF EINSTEIN'S EQUATIONS. Koppel, A. (Tartu State Univ.). Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 23: No. 4, 370-378(1974). (In Russian).

A certain method is developed for finding nonrelativistic limit to the stationary relativistic gravitational field described by two-variable metric form. The method is based on H. Keres's works. With the help of the formulas derived it is possible to analyze and interpret a wide class of solutions of Einstein's equations, e.g., the Kerr-Taub-NUT solutions, the Lewis-Papapetrou axially symmetric stationary solutions, the Weyl static solutions, and others. (auth)

27926 PRINCIPLE OF EQUIVALENCE AND THE CENTER OF INERTIA AND THE CENTER OF GRAVITY FUNDAMENTAL THEOREMS. Treder, H. J. (Central Inst. for Astrophysics, Potsdam, Ger.). Exp. Tech. Phys.; 22: No. 1, 1-5(1974). (In German).

In a (nonrelativistic) theory of gravitation without the strong principle of equivalence the center of inertia fundamental theorem becomes invalid; but, the same fundamental theorem for the center of gravity is fulfilled, further. In this case, the Galilei-invariant equations of motion are not the Euler–Lagrange equations of an action integral. (auth)

27927 MEANING OF THE INDUCTION OF INERTIA BY THE GRAVITATION POTENTIAL (ACCORDING TO WEBER–RIEMANN OR MACH–EINSTEIN) FOR THE EINSTEIN SHIFT. Treder, H. J. (Central Inst. for Astrophysics, Potsdam, Ger.). Exp. Tech. Phys.; 22: No. 3, 173-184(1974). (In German).

The gravitational effects on light are discussed for some generalizations of the Newtonian potential resulting from the conception of the induction of inertia by gravitation. It is proven that the correct value of the Einstein shift results from the calculations of the energy-terming of the atoms. Corresponding to GRT, Riemann's of Einstein's mass induction are giving corrections to the next order, only. Further, the general proportion of the other optical effects by the gravitation field is discussed according to Riemannian dynamics "with Mach–Einstein-doctrine." (auth)

27928 TEST PARTICLES WITH INTERNAL STRUCTURE IN A RIEMANNIAN SPACETIME. Fuchs, H. (Central Inst. for Astrophysics, Potsdam, Ger.). Exp. Tech. Phys.; 22: No. 3, 185-190(1974). (In German).

A variational principle is given for the motion of test-bodies in a Riemannian space-time. With momentum-vector and spin-tensor defined in Papapetrou's equations for spinning test particles follow from the Euler–Lagrange-equations. (auth)

27929 THREE TYPES OF SOLUTIONS OF THE EINSTEIN–MAXWELL EQUATIONS. Khlestkov, Yu. A. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz.; 68: No. 2, 387-391(Feb 1975). (In Russian).

Three types of exact solutions of the Cauchy problem for the equations of gravitation which depend on two arbitrary functions of the radial coordinate and a constant are obtained for centrally symmetric nonstationary worlds consisting of dust matter and the electromagnetic field of charges. An expression is derived for the extreme energy of particles accelerated by an electric field and scattered in the field of isotropic radiation in such worlds. (auth)

27930 GRAVITATIONAL SYNCHROTRON RADIATION EMITTED BY A PARTICLE IN A KERR OR SCHWARZSCHILD FIELD. Ternov, I. M.; Khalilov, V. R.; Chizhov, G. A.; Maglevannyi, I. I. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 68: No. 2, 377-386 (Feb 1975). (In Russian).

A detailed analysis is presented of the properties of the gravitational synchrotron radiation (GSR) emitted by a particle moving along an unstable circular geodesic trajectory in a Kerr field. Formulas are derived which describe the spectral-angular, spectral and angular distributions of the GSR intensities divided with respect to polarization states. Rotation of the plane of polarization of a gravitational wave propagating in a Kerr field is considered. The differences in the properties of GSR are considered for a source moving along a geodesic or nongeodesic trajectory. (auth)

27931 GENERALIZED EQUATIONS OF INERTIAL-GRAVITATIONAL FIELDS. Raigorodskii, L. D. (Leningrad Shipbuilding Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 114-116(1974). (In Russian).

Generalized equations of inertial-gravitational fields, which contain quasi-Maxwellian field equations, were obtained. (tr-auth)

27932 VARIATIONAL PRINCIPLES IN A THEORY OF INERTIAL-GRAVITATIONAL FIELDS. Raigorodskii, L. D. (Leningrad Shipbuilding Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 110-114(1974). (In Russian).

Variational methods and some singularities of their use in the theory of inertial-gravitational fields are examined. (tr-auth)

REACTOR TECHNOLOGY AND REGULATION

Refer also to abstract 25275.

27933 (LA-5795-C) PROCEEDINGS OF THE FIRST NATIONAL TOPICAL MEETING ON NUCLEAR PROCESS HEAT APPLICATIONS, LOS ALAMOS, NEW MEXICO, OCTOBER 1–3, 1974. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1974. Contract W-7405-eng-36. 286p. (CONF-741032-). Dep. NTIS $7.60.

Separate abstracts were prepared for 26 of the 31 papers included. The remaining 5 papers were outside the scope of NSA. (JWR)

For abstracts of individual papers see: 27934, 27935, 27943, 27958, 27959, 27971–27982, 28057, 28746, and 28811–28817.

27934 (LA-5795-C, pp 109-116) NUCLEAR PROCESS HEAT STUDIES AT WESTINGHOUSE. Jones, A. R. (Westinghouse Electric Corp., Pittsburgh). Nov 1974.

From first national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

The temperature at which heat is available is a prime factor in the consideration of process heat. This generality is applicable regardless of the fuel and heat source. It is especially true in the case of nuclear heat. There is, of course, no problem in generating any desired temperature with nuclear fission. The obvious problem lies in devising a system to deliver the heat at the desired temperature safely and economically. Numerous process heat applications have been investigated. A very few have been implemented. While the entire list of reasons may be longer, there are three major reasons: (1) The system must provide assured separation between the nuclear radioactivity and the process market; (2) the temperature available, with established nuclear plant technology, has severely limited the applications and resulting market; and (3) the possibility of recovering the development cost, for a nuclear concept with higher temperature capability, seemed remote. There is ample evidence that many people share the opinion, as does Westinghouse, that the situation is changing. The driving force for this change is the rise in cost and impending shortage of fossil fuel and it is very real. Westinghouse has been deeply involved in the design, development and construction of nuclear reactors and plants. These programs include pressurized water, liquid metal and gas reactor concepts. Over the period from 1960 to 1972, the Corporation carried out the development of the nuclear subsystem for the nuclear rocket program under AEC/NASA sponsorship. This nuclear system required, and the program generated, technology and components capable of operation over the range from −100°F to +400°F. Out of this, the NERVA program, has come a wealth of plant and fuel technology well suited to the development of an advanced nuclear process heat source. The key element in this technology is, of course, materials but it encompasses the whole range from design tools to components and testing expertise. This technology is a national resource, presently unused, which Westinghouse studies indicate can be applied in a safe high performance nuclear process heat system. The development cost will be maintained by using this technology. A further potential saving has also been identified in the on-going Westinghouse studies. These have demonstrated that this very same technology can be used in engineering variants to meet the needs of other industries and applications feeling the effects of fuel cost and scarcity. These include merchant marine and military power and propulsion and high efficiency electric power plants. This potential for sharing the benefits of the program means each application need bear only its share of the cost. Such a multi-agency development effort is recommended. (auth)

27935 (LA-5795-C, pp 247-250) NUCLEAR HEAT TRANSMISSION CONSIDERATIONS. Leeth, G. G. (General Electric Co., Santa Barbara, CA). Nov 1974.

From first national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

A preliminary analysis of various methods of exporting heat from a nuclear power plant is carried out. Energy transport in the form of electricity and natural gas is also listed for comparative purposes. The procedure consists of evaluating several different forms of energy ranging from hot water to hydrogen. In all cases, some type of pipeline is required. The evaluation is basically an economic comparison including both capital costs and energy loss costs. Additional evaluation is included in a qualitative manner by listing specific problem areas. Results indicate that hydrogen is superior to all other energy transport methods considered. An EVA-ADAM system is intermediate between hydrogen and electricity or hot water. High-voltage electric overhead transmission and hot water are the most expensive systems. In addition, for the case of a nuclear energy center, all of the pipeline methods of energy transport are superior to electric transmission from the viewpoints of heat rejection and the "getaway" problem. (auth)

27936 CZECHOSLOVAK NUCLEAR PROGRAM IN 1975. Neumann, J. Jad. Energ.; 21: No. 1, 1-2(1975). (In Czech).

27937 FRANCE, RESEARCH, AND DEVELOPMENT. Nuclear Power in France. J. Brit. Nucl. Energy Soc.; 13: No. 4, 343-346(Oct 1974).

Two aspects of nuclear energy in France are briefly reviewed. First a summary is presented of a report published by the French Embassy in London which outlines the organization and financing of research and development in France, provides information on the research establishments and gives a breakdown of the areas of research. Secondly, the nuclear power situation is briefly surveyed. A major program was recently launched; and plans for thermal reactors, fast reactor development, uranium enrichment and nuclear shipping are summarized. (UK)

27938 GENERAL PROBLEMS OF STRESS MODELING. pp 10-118 of Modelirovanie Napryazhenii v Konstruktsiyakh Yadernykh Reaktorov. Taratorin, B. I. Moscow; Atomizdat (1973). (In Russian).

Consideration is given to the theory and practical methods of stress modeling in nuclear reactors. The main method of stress modeling is a polarization-optical one in combination with calculational methods. The first part of the book contains a derivation of the conditions of similitude, the theory and practical methods of polarization-optical measurements; the characteristics and methods of investigating the optical-mechanical properties of model materials; model instrumentation for polarization-optical measurements. (tr-auth)

27939 STRESS MODELING IN ELEMENTS OF NUCLEAR REACTOR STRUCTURES. pp 119-226 of Modelirovanie Napryazhenii v Konstruktsiyakh Yadernykh Reaktorov. Taratorin, B. I. Moscow; Atomizdat (1973). (In Russian).

The second part of the book deals with the modeling, calculation and polarization-optical study of stresses in elements of nuclear reactor structures. The book presents the calculation and study of the stressed and deformed states in the body of a nuclear reactor having penetrating channels. Particular attention is devoted to local stresses, including those occurring during inelastic deformation. A special chapter deals with modeling, calculating and investigating temperature stresses. (tr-auth)

27940 TECHNOLOGY OF LINE PRODUCTION OF FINISHING AND INSTALLATION JOBS AT A NUCLEAR POWER PLANT. Ponomarev, Yu. V. Energ. Stroit.; No. 9, 9-13(1972). (In Russian).

All installation work is done at the "pure" installation stage, including assembling of the reactor core, heat-exchange equipment, and mechanisms and piping for the reactor loop. Also installed at this time are the electrical circuits, control and measuring instruments, automatic systems, and dosimetry apparatus. Combining of the "pure" installation work with structural work on the reactor plant shortened the Belo-Russian nuclear power plant work by more than 6 months. For the combination it is necessary to ensure a separate zone of "pure" installation and "impure" structural work. A list is given of the finishing-up and completion work, the carrying out of which in the proper sequence decreases the work involved. The most typical variants of the organization of the finishing work are considered. To divide the mixed crew of finishers into narrow specialized groups is not expedient since the mixed crew always carries out work faster, and the organization of such a crew greatly simplifies the management. The structural work at the Belo-Russian nuclear power plant confirmed the efficiency of working with a mixed crew of concrete workers. The basic technology of the finishing work on multistage nuclear power construction should be a flow, which develops as the structure is raised. The main subdivisions of the finishing work should be by specialized groups, the personnel of which should be from the mixed crews. (tr-auth)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 28651–28653, 28657, 28663, 28668, 28678, 28847, 28849, 28852, and 28858.

27941 (JAERI-1236) INTEGRITY ASSESSMENT FOR JPDR PRESSURE VESSEL. Fujimura, T.; Miyazono, S.; Ueda, S.; Kodaira, T.; Shibata, K. (Japan Atomic Energy Research Inst., Tokyo). Oct 1974. 96p. (In Japanese). Dep. NTIS (US Sales Only).

The steel pressure vessel of the Japan Power Demonstration Reactor (JPDR) is constructed with stainless steel weld overlay liners on the inner wall. Since the stainless steel overlay cladding is subjected to thermal and internal-pressure loads in reactor operation, it is desirable for the cladding to have higher ductility from the standpoint of structural integrity. Surveys concerning the mechanical properties and metallographic observations of the overlaid weldment are described. The experimental results of three pressure vessel models of JPDR pressure vessel are presented. (auth)

27942 (JAERI-M-5809) PRESENT STATE OF MANUFACTURING LWR PRESSURE VESSELS IN JAPAN. I. Heavy Section RPV Steels. Hasegawa, M.; Kawasaki, M.; Fujimura, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 39p. Dep. NTIS (US Sales Only).

The present status of manufacturing the heavy-section steels for LWR pressure vessels in Japan is described, including the technology and steel properties. They satisfy the requirements for nuclear reactor pressure vessels. The report is prepared for presentation at the IAEA meeting to be held at Vienna in October 1974. (auth)

27943 (LA-5795-C, pp 87-92) DESIGN AND OPERATION OF NUCLEAR POWER PLANTS FOR PROCESS HEAT APPLICATION. Cox, E. L. Nov 1974.

From first national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

The application of nuclear power for process steam generation by current technology is examined. BWR, PWR, and HTGR systems are discussed and adaptations necessary for process heat applications for each system are briefly described. (JWR)

27944 (RISO-310) IBU2-SELMA2 FUEL MANAGEMENT SYSTEM. Weber, S. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sep 1974. 75p. Dep. NTIS (US Sales Only) $6.75.

Thesis.

The IBU2-SELMA2 fuel management system consists of the two computer codes IBU2 and SELMA2. The IBU2 code calculates an ideal k_∞-distribution that has certain desired properties, e.g., a limited power form factor. The results from IBU2 are used in the SELMA2 code for separation of the multistage decisions into external and internal decisions. The external decisions are assumed given, the internal decisions are all taken by the SELMA2 program. The external decisions are: choice of IBU2 calculation, reload enrichment and cycle time. The internal decisions are: number of fresh fuel elements, which fuel elements are to be discharged and fuel element distribution. The internal decisions are all determined on the basis of the external decisions. The discharge and loading of elements depend on the reload enrichment and the cycle time in connection with results obtained by the IBU2 calculation. The fuel element shuffling is determined by requiring that the resulting k_∞-distribution fits the ideal k_∞-distribution as closely as possible. The core is described in X-Y geometry giving the advantage that a single fuel element can be followed in the fuel element re-distribution. The development and results of the two codes are described. (auth)

27945 (UCID-16666) FAULT TREE ANALYSIS OF THE EMERGENCY POWER SYSTEM OF TWO LIGHT-WATER NUCLEAR POWER REACTORS. Wells, J. E.; Savage, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Jan 1975. Contract W-7405-eng-48. 60p. Dep. NTIS $6.00.

The emergency power system of a nuclear power reactor is designed to provide the necessary power for startup, operation, shutdown, and other station requirements. During a loss-of-coolant accident (LOCA) this emergency power system provides the required amount of power to mitigate the effects of transients and accidents. The problem of having "insufficient power" available to the Engineered Safety Features (ESF) during LOCA is analyzed. Fault tree analysis techniques, both qualitative and quantitative, were used to obtain this information. The results of these analyses are described. (7 references) (auth)

27946 ABNORMAL OCCURRENCES IN 1973. J. Brit. Nucl. Energy Soc.; 13: No. 4, 347-349(Oct 1974).

A summary is given of data on abnormal occurrences in US reactors in 1973, which was extracted from reports to the USAEC. Information from 64 reactors is tabulated to show the fault rate and method of discovery, apparent causes in relation to reactor status or operation, and also to analyze the occurrences by the components and systems involved. (UK)

27947 OPERATION EXPERIENCE WITH NUCLEAR POWER PLANTS IN THE USSR. Voronin, L. M. Arch. Energiewirt.; 28: No. 21, 1059-1072(Nov 1974). (In German).

This contribution discusses the experience gained in the USSR in the operation of PWRs and BWRs as well as sodium-cooled fast reactors. (GE)

27948 REACTOR ANOMALY DETECTION BASED ON NOISE ANALYSIS. Hannaman, G. W. Jr. Ames, IA; Iowa State Univ. (1974). 179p. University Microfilms Order No. 75-3308.

Thesis (Ph. D.).

A forced circulation BWR noise model is developed. Transfer functions, solved in the closed form for various axial power distributions, describe the effect of inherent noise sources on the nuclear power and associated detector response. The effect of local void fluctuations on the detector response is also considered. A computer program (NMOD) was written to calculate the square modulus of the transfer functions relating input noise sources to the detector response. The model was utilized to compare the effects of changes in the operating conditions of a BWR on the detector frequency response. Individual transmission path responses were developed which can aid in the interpretation of power spectral density (PSD) measurements from operating reactors. Factors causing space dependent changes in the PSD measurements are discussed. Results provide a basis for the development of an on-line surveillance system capable of detecting anomalous conditions from in-core neutron signals. (Diss. Abstr. Int., B)

27949 SAMARIUM COMPENSATION FOR NUCLEAR REACTOR FUEL. Channon, F. R.; Fischer, D. L. (to General Electric Co.). US Patent 3,849,248. 19 Nov 1974. Filed date 27 Oct 1971. 10p.

A system of burnable poison adapted to compensate for the lack of samarium in new nuclear fuel is presented. (Official Gazette)

27950 BOILING WATER REACTOR. Fujisaki, Y.; Nei, H. (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1973-18438/B/. 4 Mar 1968. 3p. (In Japanese).

A description is given of a boiling water reactor in which the sub-cooling of driven water is effectuated by the driving water discharged from a jet pump. A jet pump and a heat exchanger are provided in the reactor. The latter is connected between a jet pump nozzle and a pipe end. The supplied driving water is allowed in the heat exchanger to subcool the driven water of saturation temperature. The apparatus is designed to prevent cavitation in the jet pump. Accordingly, the water supplied from the outer distributing system is capable of accomplishing the subcooling of the driven water, being totally utilized for the driving purpose. The apparatus permits the power required for water pumping to be decreased to promote plant efficiency. (JA)

27951 THE BEHAVIOR OF BWR FUEL ELEMENTS DURING POWER OPERATION. Principles and Data. Eickelpasch, N.; Seepolt, R. W. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen/Guenzburg (F.R. Germany)); Wolff, U. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Essen (F.R. Germany). Abt. Kraftwerke). At. Strom; 20: No. 9/10, 99-108(Oct 1974). (In German).

22 figs.; 27 refs.

Methods are described for inspecting fuel elements both during reactor operation and outside the reactor. By using examples of fuel elements in the nuclear station at Gundremmingen the evaluation and the results from the more important methods are presented. (auth)

27952 CORROSION RESISTANT WELDED LININGS FOR NUCLEAR POWER PLANTS. pp B1.409 of Steel-Iron Materials Specifications. Duesseldorf, F.R. Germany; Stahleisen Verl. (Mar 1972). (in German).

Loose-leaf binding.

Demand for welded linings of primary components of water-cooled nuclear power plants is underscored, and guide lines for the choice of additional welded materials as well as for the manufacture and testing of the welded linings are given. (GE)

27953 BWR BOILERS IN FRANCE. Normier, C. (Societe Generale pour l'Entreprise de Reacteurs et de Centrales Atomiques (SOGERCA), 92-Le Plessis Robinson (France)); Panossian, J. (Groupement pour les Activites Atomiques et Avancees (GAAA), 92-Le Plessis-Robinson (France)). Kerntechnik; 16: No. 1, 483-484(Nov 1974).

1 ref.

Electricite de France ordered 8 BWR boilers from Compagnie Generale d'Electricite. SOGERCA, holder of the General Electric licence and subsidiary of Alsthom, has the overall responsibility

for the BWR activities. The first boiler, St. Laurent III, type BWR 6 Mark III, of 1,000 MW electric output will be put in operation in 1979. (auth)

27954 STATUS AND DEVELOPMENT OF REACTOR PRESSURE VESSELS. Stuenkel, D. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F.R. Germany). Abt. Ingenieurwesen); Bremer, F. (Krupp (Friedr.) G.m.b.H., Essen (F.R. Germany). Universalbau); Ruf, R. (Kraftwerk Union A.G., Erlangen (F.R. Germany). Hauptabteilung Primaerkreis-Komponenten); Schilling, F.E. (Siempelkamp Giesserei K.G., Krefeld (F.R. Germany)). Atomwirt., Atomtech.; 19: No. 11, 530-536(Nov 1974). (In German).

8 figs.

Steel pressure vessels for LWRs have attained an almost mature development status. The main interest of present and future activities lies in the field of safety techniques, with the question of security of the containers' integrity of special importance. An essential stage of development is the in-service inspection. Studies have been carried out on an additional burst protection. Prestressed pressure vessels for gas-cooled reactors also have attained a mature status regarding design and technical realization. Future activities are concentrated on the development of containers for HTRs of great capacity offering new fields for the application of HTRs (such as direct cycle gas turbine as well as nuclear process heat). An interesting alternative of the pressurized concrete pressure vessel may be the concept of the cast iron pressure vessel. This concept is adequately developed to permit a general statement on its realization to be made. (auth)

27955 REMOVABLE UPPER TIE PLATE. King, L. L.; Marshall, R. K. (to Exxon Nuclear Co., Inc.). US Patent 3,864,211. 4 Feb 1975. Filed date 2 Oct 1972. 6p.

In a nuclear power reactor fuel bundle assembled by tie rods extending between the upper and lower tie plates, the upper tie plate is secured by pre-indexed locking cams which are adjustably fitted to the upper ends of the tie rods and which lock into seats machined into the body of the upper tie plate. During assembly of the fuel bundle, the cams are forced through internal passageways in the tie plate which rotate the cams into a position from which they may enter their respective seats, urged by torsion springs fitted onto the tie rods. Compression springs around the fuel rods hold the tie plate in position by maintaining the cams in their seats. The construction facilitates the disassembly of the fuel bundle for removal of defective or spent fuel rods and permit their replacement under remotely controlled conditions. (Official Gazette)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 27942–27947, 27952, 27954, 28077, 28645, 28651, 28653, 28657, 28663, 28678, 28801, 28846, 28848, 28850, 28851, 28853–28856, and 28875.

27956 (BAW-3647-31) PHYSICS VERIFICATION PROGRAM. Part III. Task II. Quarterly Technical Report, April–June 1974. Baldwin, M. N. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Research and Development Div.). Nov 1974. Contract AT(11-1)-3109. 18p. Dep. NTIS $4.00.

In experimental Task 11, the reactivity and power perturbation effects of poison pins in mockups of 17 by 17 fuel assemblies are being measured. The experimental facility—a water-moderated, slightly enriched UO_2 lattice—is arranged to mock-up the fuel assemblies of a commercial pressurized water reactor. Each assembly contain 24 poison pin positions. (12 references) (auth)

27957 (EGU-07360301) DOSIMETRIC CONTROL IN A NUCLEAR POWER PLANT WITH THE VVER REACTOR. Jancik, O.; Moravek, J.; Kubik, I. (Vyskumny Ustav Energeticky, Jaslovske Bohunice (Czechoslovakia)). 1972. 53p. (In Slovak).

Relations are presented which describe the time dependence of radioactivity of the corrosion and fission products in the coolant and on the surfaces of the primary circuit of a pressurized water reactor. The activity analysis set the requirements for dosimetric control of the primary circuit of a VVER reactor with respect to a planned unit with an output of 1000 MW(e). (auth)

27958 (LA-5795-C, pp 157-160) MIDLAND NUCLEAR PROCESS STEAM/ELECTRIC PROJECT. Kessler, W. E. (Consumers Power Co., Jackson, MI); Burroughs, J. R. Nov 1974.

From first national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

A dual-purpose nuclear facility being constructed in Midland, Michigan to serve Consumers Power Company's electrical requirements and Dow Chemical Company's Process Heat requirements, is described. (auth)

27959 (LA-5795-C, pp 188-201) SMALL REACTORS FOR PROCESS HEAT. MacPherson, H. G. (Inst. for Energy Analysis, Oak Ridge, TN); Klepper, O. H. Nov 1974.

From first national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Surveys of some of the larger industrial plants in the chemical, paper and rubber industries indicate a significant use of process steam at moderate temperatures (less than 600°F), in capacities ranging from 300 to 1000 MW(t). Such uses of process steam are compatible with power levels and temperatures available from small pressurized water nuclear reactors, of which the Babcock and Wilcox 313 MW(t) CNSG is taken as a prototype. Cost studies of both land and barge mounted reactors have been made. Although the cost of steam from such reactors seems high for the smallest reactors considered, it may still be competitive with fossil fuels in some parts of the country. The cost comparisons improve as the size of the reactor installation increases. (auth)

27960 NUCLEAR POWER IN SWEDEN. Halle, L. (ASEA-ATOM AB, Vaesteraas, Sweden). J. Brit. Nucl. Energy Soc.; 13: No. 4, 363-374(Oct 1974).

The history and development of nuclear power in Sweden is recounted. Figures are quoted for electricity generation and forecasts to 1990. The activities of ASEA-ATOM and other manufacturers of nuclear components in the industry are described. The ASEA-ATOM BWR design incorporates a number of special features in the containment, fuel assembly, control rod drives, and emergency cooling system, and details are given of these. (UK)

27961 LIGHT WATER REACTOR PRIMARY COOLANT LEAKAGE MONITOR. Martucci, J. A. (to Combustion Engineering Inc.). US Patent 3,849,655. 19 Nov 1974. Filed date 15 Dec 1972. 10p.

This invention consists of a method for the detection of leakage of a first fluid into a second fluid or into the surrounding atmospheric envelope. The first fluid is irradiated with high energy radiation to produce radionuclides which decay with the characteristics emission of angularly correlated radiations. One example of such a radionuclide is a positron emitter which decays with the emission of a positron which immediately annihilates with an electron. Two gamma photons are released from the positron-electron annihilation event and the gamma photons propagate in opposite directions. A sample of the second fluid is monitored by at least two scintillation detectors oriented to correspond with the characteristic angles of the angularly correlated radiations. The detectors are electrically connected to coincidence circuitry. Only those pairs of radiation emissions which simultaneously activate the angularly positioned scintillation detectors are registered on a counter. (Official Gazette)

27962 SPECTRA COMPOSITION OF RADIATION IN ROOMS OF THE SECOND UNIT OF THE NOVO-VORONEZH NUCLEAR POWER PLANT. Glushchenko, A. I.; Orlov, Yu. V.; Satarin, V. E. Vop. Fiz. Zashch. Reaktorov; No. 6, 93-98(1974). (In Russian).

The spectral distribution of the γ radiation and neutrons at various points in the central room of the second unit was measured during start-up of the reactor. The results are shown graphically and the origin of the radiation detected is discussed. (7 references) (JSR)

27963 ABSOLUTE FLUXES AND SPECTRA OF FAST NEUTRONS INCIDENT ON THE REACTOR VESSEL OF THE SECOND UNIT OF THE NOVO-VORONEZH NUCLEAR POWER PLANT. Barinov, A. L.; Vikin, V. A.; Glushchenko, A. I.; Egorov, Yu. A.; Kovalenko, V. V.; Luk'yanov, M. A.; Orlov, Yu. V.; Razumovskii, M. V.; Tsofin, V. I. Vop. Fiz. Zashch. Reaktorov; No. 6, 83-93 (1974). (In Russian).

One of the basic problems in the construction of nuclear power plants with water-water reactors is guaranteeing the radiation stability of the vessel. For accurate determination of the magnitude of the radiation damage of the vessel it is necessary to know the energy distribution of neutrons in absolute units with energy above 0.2 to 0.5 MeV. These data were obtained during start-up of the second unit by means of threshold detectors. The effective cross section method and expansion by linear combinations of the cross sections were used for reduction of the neutron spectra. The results obtained are shown graphically. (16 references) (JSR)

27964 CONSTRUCTION OF IKATA NUCLEAR POWER STATION. Nonaka, H. (Shikoku Electric Power Co., Ltd., Takamatsu, Japan). Karyoku Genshiryoku Hatsuden; 25: No. 1, 21-30(Jan 1974). (In Japanese).

The construction of Ikata nuclear power station is proceeding, with completion expected in April 1977. Situated on a peninsula of Ehime Prefecture, the power plant is equipped with a PWR with electric output of 565 MW. The following are described: siting; facilities including a reactor, a turbine, a sea-water desalination device, a waste disposal facility, and electrical equipment; power station layout; construction work; and preservation of the environment. (JA)

27965 DESIGN AND FABRICATION OF PRESSURISED WATER NUCLEAR STEAM SUPPLY SYSTEMS IN FRANCE. Lefebvre de Ladonchamps, J. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92-Courbevoie (France)). Kerntechnik; 16: No. 11, 485-489(Nov 1974).

10 figs.; 1 tab.

Pressurized water nuclear steam supply systems at Fessenheim and Bugey are described. This type of nuclear steam supply system has been chosen for the implementation of the major part of the French nuclear power development program. A brief discussion of the mode of operation of the reactor and a brief description of its major components are followed by a review of the available fabrication facilities, with particular reference to the Framatome workshops at Le Creusot and Chalon-sur-Saone where the reactor pressure vessels and the steam generators are fabricated. Emphasis is placed on the importance attached to problems of nuclear quality control. (auth)

27966 INLET FLOW OSCILLATION DAMPER FOR A NUCLEAR REACTOR. Tong, L. S. (to Westinghouse Electric Corp.). US Patent 3,864,209. 4 Feb 1975. Filed date 30 Oct 1972. 4p.

The coolant flow entering through the inlet annulus of a liquid cooled nuclear reactor, formed by the cylindrical wall of the pressure vessel and the cylindrical wall of the core barrel supportedly suspended within the vessel, may be subject to oscillations due to vorticity imparted thereto. An inlet flow damper comprising a generally annular member constructed from one or more ring-like turning vanes situated adjacent the inlet nozzle functions to suppress such oscillations. (Official Gazette)

27967 THERMAL SHIELD OF A NUCLEAR REACTOR. Singleton, N. R. (to Westinghouse Electric Corp.). US Patent 3,868,302. 25 Feb 1975. Filed date 12 May 1971. 6p.

The thermal shield for the core of a nuclear reactor in which the core has portions closer to the inner wall than other portions has an increased thickness adjacent the portions closer to the wall. (Official Gazette)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 27943, 27954, 28078, 28654, and 28655.

27968 (CEA-CONF-2716) USE OF HIGH-TEMPERATURE GAS LOOPS FOR QUALITY AND SAFETY TESTS. Desandre, C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France)). 20 Jun 1974. 42p. (In French). (CONF-740742-1). Dep. NTIS (US Sales Only) $5.25.

From meeting of the Euratom work group on irradiation devices; Harwell, UK (2 Jul 1974).

27969 (GA-A-12985) HTGR CORE THERMAL DESIGN METHODS AND ANALYSIS. Shenoy, A. S.; McEachern, D. W. (General Atomic Co., San Diego, Calif. (USA)). 31 Dec 1974. 327p. (GA-LTR-17). Dep. NTIS $19.50.

The methods employed in carrying out the thermal analysis of the core of a High-Temperature Gas-Cooled Reactor (HTGR) are described. The thermal design basis, computer codes, and thermal data used are presented. The information on design basis and data is applicable to all commercial HTGR core sizes: 2000, 3000, and 3800 MW(t). Core designs for different size plants employ the same core components, coolant conditions, and nearly the same power density. The principal difference between the three cores is the number of fuel columns employed. The core description and core performance results given are for the 3000 MW(t) plant. Descriptions presented of core design methods and methods of modeling of the core thermal behavior are for those currently in use at GA. Core performance results of the 3000 MW(t) plant are presented to demonstrate the application of the design methods. (auth)

27970 (INIS-mf-1482) OECD HIGH TEMPERATURE REACTOR PROJECT DRAGON. 14th Annual Report, 1 April 1972-31 Mar 1973. (Nuclear Energy Agency, 75-Paris (France)). 1973. 112p. (In English and French). INIS.

The following activities and programs are described: the irradiation program, physics calculations, thermal analysis, stress analysis, fuel element design, fuel operations, reactor operation, reactor evaluation, in-core temperature measurement, fuel handling equipment, reactor safety, the installation of experimental duct liners, replacement of the Dragon inner reflector, disposal of irradiated and unirradiated fuel, fuel and graphite research and development, fuel fabrication technology, primary circuit materials, reactor physics, fission products and circuit activity, HTR chemistry, safety studies, helium technology, gas turbine (direct cycle) studies, staff, board of management, contracts, finance and accounts. (INIS)

27971 (LA-5795-C, pp 62-69) HISTORY OF NUCLEAR PROCESS HEAT APPLICATIONS IN THE UNITED STATES. Green, L. Jr. (Atomic Energy Commission, Washington, DC); Anderson, T. D. Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Background information on the applications of nuclear process heat is reviewed and the current revival of interest in nuclear process heat is discussed. The current U. S. program for development of process heat HTGRs is described and future prospects are surveyed. (JWR)

27972 (LA-5795-C, pp 93-98) AEC PROGRAMS FOR NUCLEAR PROCESS HEAT DEVELOPMENT. Womack, E. A. Jr.; Laughon, K. O. (Atomic Energy Commission, Washington, DC). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

The increased temperature capabilities of the gas cooled nuclear reactor suggest the potential for coupling a Very High Temperature Reactor (VHTR) with systems for coal processing, steel production, and ultimately hydrogen production via thermochemical water splitting and other methods. The USAEC, in cooperation with industry and other Government organizations, has undertaken the task of evaluating conceptual VHTR systems for use in process applications requiring temperatures of 1200 to 2000°F. This activity is the first step in the development of a program plan for future USAEC development of reactor systems for high temperature process heat applications. At the same time, research and development programs are being initiated on technical problems for which it is already apparent that work is needed; i.e., high temperature reactor fuels, materials, and systems analysis. Engineering development of systems and components will be undertaken once the program plan is completed and the development needs have been better defined. The research and development programs and requirements for the VHTR are discussed and the status of current planning activities in this area are reviewed. (auth)

27973 (LA-5795-C, pp 99-108) HIGH TEMPERATURE REACTOR AND PROCESS HEAT EVALUATION. McNelly, M. J.; Tschamper, P. M. (General Electric Co., Sunnyvale, CA). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Some of the overall considerations evolving from a current study of the application of high temperature reactors to various sectors of the process heat market are presented. Both prismatic and pebble bed core designs are identified as potential candidates. The relatively early stage in development and cumulation of relevant operating experience is noted. Several major and as yet undecided design options for the plant and its fuel cycle are identified. Problems of cost estimating and assessment of economic payoff at this stage of development are stressed. A series of six basic program recommendations are developed. (auth)

27974 (LA-5795-C, pp 117-123) HTGR AND PROCESS EVALUATION. Quade, R. N. (General Atomic Co., San Diego, CA). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Significant nonelectric applications of the HTGR have been identified, including coal gasification/liquefaction, steelmaking, hydrogen production, and tertiary oil recovery. The advantage of the HTGR design as related to these applications is discussed. (auth)

27975 (LA-5795-C, pp 136-146) DESIGN AND DEVELOPMENT OF AN HTGR FOR MULTI-PURPOSE UTILIZATION IN JAPAN. Murata, H.; Kawasaki, M.; Ishikawa, H. (Japan Atomic Energy Research Inst., Tokyo). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Japan Atomic Energy Research Institute (JAERI) plans to complete an experimental gas cooled reactor, VHTR (50 MWt, outlet temperature of reactor 1,000°C). Research and development works are going on, such as design study of the reactor, development of fuels and structural materials, and high temperature technology with helium gas loops including an in-pile gas loop. The present activities and works, concerning the fundamental conceptual design of the reactor including its process heat system, construction and operation experiences of out-of-pile high temperature helium gas loops, development of reactor fuels and high temperature materials (metallic and graphite materials), and also construction plan of an in-pile loop (OGL-1) are described. Feasibility studies of a large HTGR (3,000 MWt, outlet temperature of reactor 1,000°C) for process heat applications, especially for nuclear steel-making, are explained. The Engineering Research Association of Nuclear Steelmaking (ERANS) is promoting the national project for the development of iron and steel-making by nuclear energy. The outline of the project is also described. (auth)

27976 (LA-5795-C, pp 147-156) NUCLEAR PROCESS HEAT PROGRAMMES IN GERMANY. Harder, H. (Hochtemperatur-Reaktorbau GmbH, Mannheim, Ger.); Fischer, R. Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

A survey is given on the current German program for the development of coal gasification by means of nuclear heat. The activities of the industry engaged in this field and proposals for a comprehensive nuclear process heat development program, including the construction and operation of a demonstration plant, are presented. (auth)

27977 (LA-5795-C, pp 161-168) HTGR FOR COAL GASIFICATION/LIQUEFACTION. Quade, R. N. (General Atomic Co., San Diego, CA); Woebcke, H. N. Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

A solution hydrogasification process for converting bituminous or subbituminous coal to a substitute methane gas and a light aromatic liquid fuel using heat from an HTGR to generate hydrogen, steam, and power required for the process is described. The coal solution technique eliminates the requirement for coal pretreatment and yields coal monomers more reactive than the parent coal. This same basic HTGR-coupled process can be easily modified to produce a clean liquid boiler fuel, hydrogen, or electricity in combination with the basic methane output. (auth)

27978 (LA-5795-C, pp 169-179) USE OF NUCLEAR ENERGY IN STEELMAKING: PROSPECTS AND PLANS. Blickwede, D. J. (Bethlehem Steel Corp., PA); Barnhart, T. F. Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Possible uses of nuclear energy in steelmaking processes are examined. These possibilities include heat for direct reduction and electricity for electric furnace refining. Economic aspects are examined in detail and costs for conventional refining are compared with those from a system using an HTGR. It is concluded that there is a reasonable economic justification for developing a nuclear steelmaking system. (JWR)

27979 (LA-5795-C, pp 180-187) HYDROCARBON RECOVERY AND PROCESSING APPLICATIONS OF AN HIGH TEMPERATURE GAS-COOLED REACTOR (HTGR). Talley, W. W. II. (Resource Analysis and Management Group, Oklahoma City). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

The applications of High Temperature Gas-Cooled Reactors (HTGR) as the primary energy source for the production and upgrading of tar sands and heavy crude oil are discussed. Additionally, process requirements and applications for the High Temperature Gas-Cooled Reactor as the primary energy source for upgrading crude shale oil and petroleum refining are presented. The location and magnitude of tar sand, heavy crude oil and oil shale resources suitable for process heat applications are identified. The pertinent reservoir characteristics and energy requirements for in-situ recovery, upgrading and refining are identified. Specific applications of the High Temperature Gas-Cooled Reactor to petroleum refining are presented with typical refinery heat loads and temperature requirements identified. The use of High Temperature Gas-Cooled Reactors in an integrated resource recovery, upgrading and refining plant is discussed. The most likely areas of application of High Temperature Gas-Cooled Reactor process heat are evaluated and potential limitations are discussed. (auth)

27980 (LA-5795-C, pp 202-209) NUCLEAR PROCESS HEAT AND DIRECT COAL GASIFICATION. Cohen, S. (Aerojet Nuclear Co., Idaho Falls, ID). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

The methods of applying nuclear process heat to coal gasification define indirect and direct coal gasification. An evaluation of a nuclear process heat source to supply the energy required for direct coal gasification is made. The gasification system requirements are developed which determine both the nuclear system and interface design. Heat transfer requirements between the nuclear system and process system are examined and a fluid bed heat exchanger concept presented. The heat transfer parameters influencing nuclear reactor design are shown to require extensive changes from present technology. (auth)

27981 (LA-5795-C, pp 210-227) COAL GASIFICATION AND OTHER NUCLEAR PROCESS HEAT APPLICATIONS. Schulten, R.; Kugeler, K. (Kernforschungsanlage, Juelich, Ger.). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

The processes of coal gasification with steam, of hydrogasification and of nuclear heat piping systems are described. Technical information about helium heated steam reformers and some aspects of the nuclear reactors for process heat is given. Some arguments to develop the technology of nuclear process heat belonging to the German situation are added. (auth)

27982 (LA-5795-C, pp 237-246) HYDROCARBON REFORMING USING AN HTGR. Fontaine, R. W.; King, J. H.; Morse, D. C.; Peterman, D. D. (General Atomic Co., San Diego, CA). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Steam reforming of light hydrocarbons (most commonly methane) is a standard process for production of hydrogen. Present-day applications are primarily in ammonia production and petroleum refining. Promising future applications include production of reducing gas for direct reduction of iron ore and production of hydrogen for a coal gasification process being developed by General Atomic, Stone & Webster, and Gulf Oil. Conventional reformers are tubular units with catalyst pellets packed inside the tubes. The tubes are heated externally by combustion of hydrocarbon fuels. Reforming is typically carried out at temperatures in the range of 700° to 900°C (1290° to 1650°F). Studies at General Atomic have been directed toward the design of a steam-methane reformer heated by helium from an HTGR. Use of the HTGR as a heat source places a number of special requirements on the reformer design, principally those associated with (1) reduced accessibility to the reformer for maintenance, (2) increased reliability requirements, (3) a greater incentive for compact reformer design, and (4) the need to return helium to the reactor core at a relatively low temperature. These special requirements suggest that novel approaches to reformer design may be desirable. In most of the General Atomic studies to date, the reformers and associated process steam generators have been located inside cavities in the prestressed concrete reactor vessel (PCRV), heated directly by primary coolant helium. An alternative arrangement, in which an intermediate helium loop transports heat

from the primary coolant to reformers located outside the PCRV, has also been considered. (auth)

27983 (TID/SNA-426) PROPOSAL NO. 681113 TO GULF GENERAL ATOMIC, INC. FOR PHASE I OF THE STEAM GENERATOR PLENUM SERVICE SYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Feb 1968. 130p. Dep. NTIS $9.50.

The overall objective of the Steam Generator Plenum Service System Program is to provide the necessary equipment, systems and components to perform inspection, maintenance, and repair of the structures and equipment located in the Steam Generator Plenum (lower cavity) of the prestressed concrete reactor vessel (PCRV) for a 330 MW(e) High Temperature Gas-Cooled Reactor Plant (HTGR). Estimated costs and program management requirements are presented. (auth)

27984 DESIGN DEVELOPMENT OF THE HTGR CORE AND ITS SUPPORT STRUCTURE-SEISMIC CONSIDERATIONS. Neylan, A. J.; Gorholt, W. (General Atomic Co., San Diego, Calif. (USA)). Nucl. Eng. Des.; 29: No. 2, 231-242(Dec 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The development of the core support structure design from that employed on Fort St. Vrain to recently announced contracts by Philadelphia Electric, Delmarva Power and Light and Southern California Edison for the large HTGR is discussed. Particular emphasis is given to the seismic considerations in the design of the structure for the large HTGR. The overall configuration of each reactor type is critically compared. Although similar components are employed, the basic difference in layout configuration results in significant conceptual differences in the structural and mechanical requirements of the core support components. The configuration and major components for the large reactor are described in some detail. The essential features and function of components are discussed. The graphite components in the core support floor and permanent reflector are designed to form a tight array during reactor normal operating conditions. This composite structure resists compressive loading due to differential gas forces and concrete pressure vessel movement. This tight array concept has important advantageous effects on primary coolant flow distribution and seismic capability. The inherent requirements and methodology in developing a standard plant design for high seismic sites are discussed. A design suitable for 0.15 g operating basis earthquake and 0.25 g safe shutdown earthquake has been developed which is applicable for over 80% of the expected sites in the USA. The HTGR core and support structure consists of many thousand graphite elements. It behaves as an inelastic body having random response when subjected to seismic excitation. Simplified analytical models which have been developed to investigate this phenomenon are examined. An overview of a test program to substantiate and correlate with the analytical models is provided. The program addresses the interelement collision forces and frequencies of elements within the core and the load/deflection at the boundary. Various one, two and three-dimensional scale models have been tested. A summary of the objectives of the program is provided. (auth)

27985 MAGNOX FIN WAVING AND CHEMICAL INHIBITORS. Noden, J. D. (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc.; 13: No. 4, 407-410(Oct 1974).

Post-irradiation examination of helically finned fuel elements from Dungeness A reactors showed significant fin waving. The causes of the deformation are discussed. The major source of strain arose from compressure stresses within the carbonaceous oxide film formed from breakdown of higher hydrocarbons. The mode of deformation observed in irradiated elements could be simulated by exposure of fuel elements to 15 vol. % n-butane CO_2/gas mixtures at 1.79 MN/m^2 pressure and at 500°C. The effect of various surface treatments on 0.76 mm Magnox AL80 strip in this environment were examined. NaOH and $NaHCO_3$ effectively reduced the deformation and NaOH treatment of a Bradwell fuel element completely inhibited fin deformation in the same environment. (UK)

27986 ANALYSIS OF REACTIVITY AND POWER DISTRIBUTION MEASUREMENTS ON AN ASYMMETRICALLY FUELLED CAGR TYPE REACTOR. Howarth, N. (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc.; 13: No. 4, 391-402(Oct 1974).

Calculations using three-dimensional homogeneous and heterogeneous reactor codes were compared with measurements performed in a complex critical CAGR type assembly. The reactor contained an axially and radially non-uniform fuel loading with a bank of four interstitial control rods partly inserted during most of the experiments. The reactivity worth of the rod insertion was determined and a large programme of axial and radial manganese reaction rate distribution measurements included axial plots in the bulk moderator simulating the CAGR ball scanning instrumentation. Large systematic discrepancies were observed between calculation and experimental measurements of axial power shapes: these are subsequently referred to as tilts. On this reactor the tilts could easily be normalized out of the theoretical results using the bulk moderator plots. These tilts will be important for CAGR operational purposes because uncertainties in the data used will be greater than for the experimental situation and the reduced axial leakage will render a CAGR more sensitive to asymmetric changes in data. Other smaller systematic errors were identified and possible causes are discussed. (auth)

27987 MINERAL INSULATED THERMOCOUPLES IN POWER PRODUCING NUCLEAR REACTORS. Guneratne, P. P. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). Atom (London); No. 216, 242-248(Oct 1974).

From TempCon conference; Brighton, Eng. (26 Mar 1974).

It is stated that replacement of temperature sensors in reactors because of failure is not always possible, and high integrity and reliability are necessary. Compatibility of materials is of the utmost importance. Temperatures measured are in general up to about 900°C, and for the purpose mineral insulated, metal sheathed thermocouples having Ni/Cr, Ni/Al conductors are found to be the best choice for use in reactor cores. Application to Magnox and the Advanced Gas-cooled reactors is described and the following factors are discussed— incidence and investigation of faults; failure mechanisms and remedial action; and difficulties with small diameter thermocouples. (UK)

27988 A NUCLEAR ELECTRIC PLANT. (To British Nuclear Design and Construction Ltd., Whetstone). French Patent 2179970/A/. 11 Apr 1973. Priority date 12 Apr 1972, United Kingdom of Great Britain and Northern Ireland. 10p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The nuclear power plant contains a reactor core, at least one primary steam generator, at least one primary circuit device for the circulation of the coolant in the core and the primary steam generator, a steam turbine designed feed the primary circuit device, and at least one auxiliary steam generator heated by the coolant and producing water vapor which is transmitted to the steam turbine. (tr-FR)

27989 A NUCLEAR REACTOR AND A METHOD FOR OPERATING SAME. Hosegood, S. B. (To Commission of the European Communities, Luxembourg). French Patent 2178138/A/. 28 Mar 1973. Priority date 29 Mar 1972, United Kingdom of Great Britain and Northern Ireland. 10p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The procedure for operating a nuclear reactor with a core in a pressurized vessel consists in forming the reactor core with blocks of moderator material containing nuclear fuel and having channels for the circulation of the coolant and the introduction of control rods and with blocks of moderator material surrounding the blocks containing the nuclear fuel. The upper part of the core has initially two layers of blocks without fuel so that after an initial operating period the lower layer of fuelless blocks can be replaced by new fuel using a machine. Such a procedure is particularly convenient for the reloading of a reactor cooled by a gas such as helium. (tr-FR)

27990 STEAM TURBINE DRIVEN CIRCULATORS FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. I. Design. Yampolsky, J.; Cavallaro, L.; Thurston, G. C.; Nichols, M. K. (Gulf General Atomic Co., San Diego, CA). J. Eng. Power; 96: No. 2, 95-101(Apr 1974).

From winter annual meeting; New York (26 Nov 1972).

Design features of the series steam turbine driven helium circulator and the basis for the adopted design solutions are discussed. Each circulator employs a single-stage axial compressor driven by a single-stage turbine in series with the main steam turbogenerator. The circulator is lubricated by water and is capable of variable speed operation. (auth)

27991 STEAM-TURBINE-DRIVEN CIRCULATORS FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. II. Development. Barbat, V. J.; Kapich, D.; Dahms, F. C.; Yampolsky, J. (Gulf General Atomic Co., San Diego, CA). J. Eng. Power; 96: No. 2, 102-108(Apr 1974).

From winter annual meeting; New York (26 Nov 1972).

The experimental development program for the series steam-turbine-driven helium circulator is discussed under the headings of aerodynamics, compressor noise, primary coolant shutoff valve, waterbearings and rotor dynamics, seals, blade vibration, disk catcher, and tests. (DG)

27992 REACTOR DEVELOPMENT FOR HIGH TEMPERATURE PROCESSES. Shepherd, L. R. Energ. Nucl. (Milan); 22: No. 3, 131-140(Mar 1975).

From 13th nuclear energy conference on nuclear energy in perspective; Milan, Italy (12 Dec 1974).

The problems connected with the development of nuclear reactors to provide direct heat for high temperature chemical processes are described. This application will depend for its economic viability on the possibility of raising the temperature of the coolant to a substantially higher level than that of any chemical reaction involved. This is a fundamental requirement dictated by the need to achieve an adequate rate of heat flow from the reactor to the process. Helium temperatures from the reactor core in excess of 1,000°C are clearly desirable in order to satisfy this criterion with processes which are currently under consideration. Dual function systems are also highly desirable to obtain a maximum utilization of the heat from reactors of any given size. The current status and development progress of coated particle fuels for high temperature reactors gives complete confidence in the possibility of achieving the necessary high helium temperatures. The most difficult problems are expected to arise in connection with the materials which will be used outside the core in the highest temperature regions of the primary circuit of the reactor, particularly in the primary heat exchangers. At helium temperatures beyond 1,000°C it may not be possible to rely on the use of metals for such purposes and recourse to ceramics or graphite in components and structures might be required. 6 references. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 28810.

27993 (EBO-310-52) ABSOLUTE NEUTRON FLUX MEASUREMENT IN REACTOR KS-150 BY THE CADMIUM FILTER METHOD WITH SELF-POWERED RHODIUM DETECTORS. Rana, S. B. (Atomova Elektraren, Jaslovske Bohunice (Czechoslovakia)). Apr 1973. 39p. (In Slovak). INIS.

Presented are principles of neutron flux measurement with self-powered Rh detectors, response functions of the detector, wiring diagrams of measuring instruments, and relations for calculating spectral parameters by the Cd-ratio method. The measurement of the response function of the detectors in an accidental reactor shutdown is described. The absolute value of the Westcott neutron flux in the bottom of the channel of the internal ionization chambers was found to be 3.68×10^8 n/cm^2 · s/MW(t). Short- or medium-lived radioisotopes can be produced in the channels during reactor operation. (auth)

27994 (ITEF-88) DETERMINATION OF THE PHYSICAL PARAMETERS OF THE KS-150 REACTOR. Shvedov, O. V.; Burgov, N. A.; Medzhibovskii, B. A.; Popkov, V. N.; Ryazhskii, V. I.; Valovich, I.; Rana, Sh.; Vonunise, I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 39p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.00.

During the start-up of the KS-150 reactor experiments were carried out to determine the physical parameters of the central and peripheral cells of the active zone. The differential (azimuthal and radial) distributions of the rate of activation of ^{238}U, ^{164}Dy, and ^{176}Lu and the fission of ^{235}U by neutrons of different energies were experimentally determined. The superfine structure of the neutron flux in the technological channels was obtained with consideration of the block effect in the individual fuel rods. A comparison of the reaction rate in the active zone and thermal columns made it possible to obtain the differential magnitudes of the spectral indices used for the calculation of the physical parameters, original Pu coefficient, and probability of avoiding resonance absorption. The experimental results were compared with calculations of the values obtained using the THERMOS program. (tr-auth)

27995 (KFKI-73-10) RECTIFICATION APPLIED IN THE ONE-AND-A-HALF CIRCUIT SYSTEM ORGANIC NUCLEAR POWER PLANT. Maroti, L.; Szentgyorgyi, I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Mar 1973. 22p. INIS.

The benzene concentration in the primary circuit of the one-and-a-half circuit organic nuclear power plant operating with diphenyl-benzene mixture has to be maintained at a low value /<10%/ so as to avoid considerable fouling. In this case steam of high diphenyl content is produced in the steam generator if there is an equilibrium separation. This phenomenon disadvantageously lowers the efficiency of the circuit. The investigation of the effect of rectification applied to the above system is considered. The results show that the necessary separation rate can be reached by applying a single plate if the rectifying column is of appropriate construction. (INIS)

27996 WHAT CANDU CAN DO. Sweet, C. (Polytechnic of the South Bank, London). New Sci.; 64: No. 924, 576-579 (21 Nov 1974).

Candu is the generic name for Canadian deuterium uranium reactor design. It combines a number of features which together give it distinctive qualities in operation, in economics, and in safety. Its unique feature is the use of heavy water as a moderator and a coolant. The advantage of heavy water is that it is the most effective of moderators, and achieves the best neutron economy. It accounts for much of the low cost of the Candu fuel cycle and it has the great merit of flexibility in a variety of fuel cycles. The demonstrable success of the Candu reactor hangs on the Pickering reactor; the largest in the world, it is operating at better than 80% availability, which is the world's best performance to date. Unlike the Magnox gas-cooled reactor, Candu is a pressurised reactor and uses pressure tubes in which the nuclear fuel is irradiated. The merits of pressure tubes, the high yield of plutonium from Candu and the economic merits of Candu are discussed. The future for the Candu fuel cycle and the capital costs of a Canadian nuclear programme are considered. (UK)

27997 NUCLEAR POWER: AN ENERGY SOURCE FOR CANADA. Gray, J. L. (Atomic Energy of Canada Ltd., Ottawa). pp 45-68 of Energy and the Environment. Efford, I. E. (ed.). Vancouver, B. C.; Univ. of British Columbia (1972).

A broad overview is given of the Canadian pressurized heavy water reactor concept and its relation to foreign reactor types, alternate power sources, and population safety. (CA)

27998 BRUCE COMPLEX LEADS WAY IN NUCLEAR POWER. Mod. Power Eng.; 68: No. 12, 48-49(Dec 1974).

The first of the Bruce A generating station's four units, Unit 2, is scheduled for completion in 1975. Units 1, 3, and 4 will follow in 1976, 1977, and 1978, respectively. Total cost is estimated at $1.4 billion. The Bruce station will use a dual computer control system featuring "direct digital control," extruded headers, and a new reactor shielding technique using steel balls mixed with water. (CA)

27999 CANADIAN NUCLEAR REACTORS OFFER RELIABILITY AND LOW COST POWER. Mod. Power Eng.; 69: No. 1, 46-50; 68.

The CANDU reactor system, using natural uranium as fuel and heavy water as both moderator and coolant, is the power reactor of choice for Canada's nuclear program. The success of this reactor type has resulted in several new power reactor commitments. Ontario Hydro has announced an electrical generation program which includes 8,000 MW(e) of new nuclear electric generation coming into service by 1984. New heavy water construction programs include the eventual expansion of the Bruce plant to four 800 ton-per-year plants, as well as the construction of an 800 ton-per-year plant at Gentilly. Prospects for foreign CANDU reactor sales are good—construction on a 600 MW(e) station in Argentina has already begun; Korea, Iran, and Denmark have expressed strong interest in CANDU. Possible alternate fuel cycles using plutonium and thorium are being considered for the CANDU system. (CA)

Power Reactors, Breeding

Refer also to abstracts 27947, 28071, 28073, 28643, 28644, 28648, 28661, 28677, 28679, 28681, 28684, 28685, 28687, 28699, 28703, 28729, and 28730.

28000 (ANL-CT-75-11) OUTLINE OF ACOUSTIC TECHNOLOGY DEVELOPMENT APPLIED TO LMFBR PROTECTION. Karplus, H. B. (Argonne National Lab., Ill. (USA)). Oct 1974. Contract W-31-109-eng-38. 21p. AT.

The current state-of-the-art, the potential of existing technology, the problems requiring solutions, the approach to solving problems, the magnitude of the tasks of providing solutions, and recommendations for the priorities of the various tasks are outlined. The problems involve: (1) obtaining information on the state of reactors and related equipment; (2) providing early warnings related to specific malfunctions to permit corrective action before severe damage results; and (3) locating malfunctions economically. The types of malfunctions expected to be acoustically detectable include: sodium boiling, metal impact, vibration, presence of fission gas or entrained cover gas, steam leaks in heat exchangers, small particles, displacement of components, motion of components, and departure of flow rate from the design standards. 19 references. (auth)

28001 (ANL-CT-75-27) PLASTIC WAVE PROPAGATION IN AN AXIALLY SYMMETRIC CIRCULAR CYLINDRICAL SHELL. Lin, H. C. (Argonne National Lab., Ill. (USA)). Feb 1975. Contract W-31-109-eng-38. 33p. Dep. NTIS $4.75.

The endochronic theory of plasticity has been applied to study the axially symmetric motion of a finite circular cylindrical shell subjected to an arbitrary pressure transient applied to its inner surface. The constitutive equations for thin and thick shells have been obtained. The governing equations are then solved by means of the characteristic method. It is found that there exist two characteristic waves; one corresponds to the longitudinal wave while the other represents the shear wave. A numerical example is presented for specific boundary conditions and a prescribed loading history along the axial direction. The radial displacement profiles in this analysis show the coupling effect of both longitudinal and shear waves. (auth)

28002 (ANL/EBR-087) EBR-II STEAM PLANT: OPERATING EXPERIENCE AND PERFORMANCE EVALUATION. Buschman, H. W. (Argonne National Lab., Ill. (USA)). Sep 1974. 19p. Dep. NTIS $4.00.

Operating experience with the EBR-II steam plant has been very good, and it shows that no unusual problems are associated with operating and maintaining a steam plant that has an LMFBR as the energy source. Problems that occurred and were corrected were with: control valves, pumps, weld joints, and heat-exchanger tubes. An active program of surveillance and maintenance is required to maintain high availability. Modifying the plant to use newly developed equipment is most important in solving operational problems. Usually these modifications simplify operation and improve plant factor. (auth)

28003 (ANL-RDP-34) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, NOVEMBER 1974. (Argonne National Lab., Ill. (USA)). 3 Jan 1975. Contract W-31-109-eng-38. vp. AT.

Progress is reported in the following areas: (1) EBR-2 operation and testing, (2) hot fuel examination facility, (3) LMFBR design support, (4) instrumentation and control, (5) fuels and materials development, (6) fast reactor physics, (7) reactor safety analysis and experiments, and (8) GCFR studies. (DG)

28004 (CONF-7209124-, pp 400-422) CURRENT STATUS OF FAST REACTOR PHYSICS. Redman, W. C. (Argonne National Lab., IL). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

Design characteristics and physics parameters for LMFBR type reactors are discussed. Experimental facilities and computational methods for fast breeder reactor development are described. (12 references) (DCC)

28005 (CONF-7209124-, pp 423-461) BREEDING: PRINCIPLES, PROMISE, PROGRESS, AND PROBLEMS. Redman, W. C. (Argonne National Lab., IL). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

Information on fast breeder reactors is presented concerning basic FBR type reactor characteristics, basic nuclear data, breeder reactor fuel cycles, U. S. breeder reactor development program, measurement of capture-to-fission ratios in critical assemblies, and central reactivity worth discrepancy. (23 references) (DCC)

28006 (CONF-741070-2) DESIGN AND STATUS OF THE CLINCH RIVER BREEDER REACTOR PLANT. Dickson, P. W. (Westinghouse Electric Corp., Waltz Mill, Pa. (USA)). [nd]. 26p. Dep. NTIS $4.50.

From frontiers of power technology conference; Stillwater, Oklahoma, USA (9 Oct 1974).

The design of the Clinch River Breeder Reactor as it presently exists, including the planned physical layout, the design operating parameters, and some of the hardware, is described. The key milestones as planned for criticality in July, 1982 are discussed. (JWR)

28007 (COO-2426-5) PRELIMINARY ASSESSMENT OF PROOF TESTING LMFBR CARBIDE FUELED SUBASSEMBLIES IN FTR DRIVER POSITIONS. Vitti, J. A. (ed.). (Combustion Engineering, Inc., Windsor, Conn. (USA)). Dec 1974. Contract AT(11-1)-2426. 255p. (CEND-370). AT.

A preliminary assessment of proof testing 13 prototypical LMFBR carbide fuel assemblies in FTR driver positions is presented. It is concluded that the proof testing plan is feasible and that prototypic conditions can be achieved for many of the key design and performance parameters of a commercial carbide fueled LMFBR. Conceptual design drawings are included for the preferred carbide test assemblies which are nearly identical to commercial fuel designs for fuel pin diameter, P/D ratio, and coolant velocity. Peak linear power and peak discharge burnup slightly exceed present commercial design objectives of 30 kw/ft and 73 Mwd/kg. The low operating temperature of the FTR, however, leads to nonprototypic fuel cladding temperatures. Individual assembly power history, flux and enrichments can be simulated quite well in the FTR for commercial outer zone fuel assemblies but inner zone operating conditions cannot be duplicated as well. Effects of the 13 proof test assemblies on operation are judged to be manageable with a minimum of difficulties; further studies are recommended to work out operational details. Also included is an assessment of the selected commercial design parameters using both near term and more advanced fuel performance assumptions, and using minimum doubling time rather than minimum fuel cycle cost as a basis for optimization. Results indicate that there are some incentives for higher sodium velocity and an increased core temperature rise. The carbide pin design used for the FTR evaluation is concluded to be closely representative of optimum commercial fuel design. (auth)

28008 (FEI-398) STABILIZATION OF HEAT RELEASE IN HIGH-POWER FAST REACTORS. Ilyunin, V. G.; Kuzmin, A. M.; Murogov, V. M.; Orlov, V. V.; Silaev, Yu. V.; Troyanov, M. F.; Shmelev, A. N.; Yurova, L. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 14p. (In Russian). INIS.

A quantitative evaluation is given of the loss connected with the effects of the de-equalizing of the profile of the thermal release field, and advantages are indicated which can be gained through stabilization of the thermal release field in the operation of high power fast reactors (1500 MW(e)) with oxide fuels and sodium coolant. Specific examples for the development of fast reactors with stable profiles of the heat release field are examined, including a reactor compensated by the structure and a reactor with combined U-Pu loading. (tr-auth)

28009 (FEI-408) RADIATION CONDITIONS AND PROTECTION MEASURES DURING EXPERIMENTATION AND REPAIR ON THE BR-5 REACTOR. Nikulin, M. P.; Abakushin, N. M.; Aristarkhov, N. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 22p. (In Russian). INIS.

The radiation conditions in the primary reactor circuit and in the control room under different operating conditions, the activity of the gas system of the first loop, and the activity of products recovered from the reactor are described. Data are reported on the biological shield of the reactor. Methods for carrying out the work and the safety measures taken during repair work under the conditions of radiation are described. Special attention is given to the special characteristics of repair and maintenance work on loops with sodium as a coolant. Questions on the collective, storage, and disposal of radioactive wastes and on equipment deactivation are discussed. Data are reported on the emergency situation at the primary circuit connected with leaks of the radioactive alkali metal, contamination level, and means for the elimination of accidents. (tr-auth)

28010 (FEI-429) EVALUATIONS OF ACCURACY OF NONDESTRUCTIVE NEUTRON METHODS OF FUEL BURNUP CONTROL AND BREEDING IN FAST POWER REACTOR CLUSTER. Van'kov, A. A.; Grigor'ev, Yu. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 10p. (In Russian). INIS.

Three nondestructive neutron methods to determine fuel burnup and breeding in fuel elements of the BN-350-type reactor were described. The methods were based on the registration of delayed fission neutrons induced by neutron irradiation of a packet with an external source, measurement of the spectra of resonance neutrons passing through the packet, and measurement of the transmission in a self-induction variation in the neutron Fermi spectra. Each of these methods were examined in detail. An evaluation was made of the sensitivity of the methods for specific measurement conditions. (tr-auth)

28011 (ICP-1050-I) FAST REACTOR FISSION YIELDS FOR ^{233}U, ^{235}U, ^{238}U, ^{239}Pu AND RECOMMENDATIONS FOR THE DETERMINATION OF BURNUP ON FBR MIXED-OXIDE FUELS: AN INTERIM PROJECT REPORT. Maeck, W. J. (ed.). (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs-Operations Office). Jan 1975. Contract AT(10-1)-1375. 19p. Dep. NTIS $4.00.

Fast fission yield data are presented for over 40 stable and long-lived nuclides for ^{233}U, ^{235}U, and ^{238}U irradiated in EBR-II. Also reported are preliminary fast fission yield data for ^{239}Pu. Capture-to-fission ratio measurements are reported for ^{233}U,

^{235}U, ^{238}U, ^{237}Np, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{242}Pu irradiated in the same assembly. The neutron environment for the irradiation is described. Monitors and their fast fission yield values are recommended for the determination of burnup on uranium–plutonium mixed-oxide FBR fuels. (auth)

28012 (INR-1436/14/R) 1H18N9T STAINLESS STEEL FOR FUEL ELEMENTS CANNING CORROSION BY SODIUM. Hajewska, E. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 19p. INIS.

From Polish–Italian seminar on some chemical, ceramic, and metallurgical aspects of nuclear fuels; Zakopane, Poland (29 May 1970).

The results of investigations on the corrosion of steel 1H18N9T of austeno-ferritic structure in thermal-convection loops (by liquid sodium) are discussed. The experiments were carried out in following conditions: temperature: 500, 650 and 750°C; time: 1000 and 2000 hours; flow rate of sodium: 12-15 cm/sec; average contents of oxygen in sodium: 0.038%. Small changes, due to corrosion process, have been observed in the mass and mechanical properties of the tested samples. At temperature 500°C traces of intra-crystalline corrosion were stated and at temperatures 650 and 700°C the presence of corrosion layers under which structural changes were visible was observed. Beside the homogeneous corrosion, deep pits were also noted, formed at temperatures 650 and 700°C. (auth)

28013 (KFK-1274/3) FAST BREEDER PROJECT. Third Quarterly Report, 1974. Hueper, R. (comp.). (Kernforschungszentrum Karlsruhe (F.R. Germany). Projekt Schneller Brueter). Dec 1974. 149p. (In German). (EUR-5199). Dep. NTIS (US Sales Only) $10.50.

Information on the development of fast breeder reactors in the German Federal Republic is presented concerning fuel pin performance testing, materials studies, corrosion tests, reactor physics, and safety aspects. (DCC)

28014 (LA-5697-MS) LASL ADVANCED PLUTONIUM LMFBR FUEL PROGRAM PUBLICATIONS. Leary, J. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 55p. Dep. NTIS $5.45.

Forty articles published by LASL authors are summarized. Subjects include synthesis, fabrication, properties, and irradiation testing of plutonium advanced fuels for fast breeder reactors. (auth)

28015 (NDS-9(Vol.1)) PROJECT PLANS: LMFBR LARGE VALVE TECHNOLOGY DEVELOPMENT. Volume I. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Dec 1968. 335p. Dep. NTIS $19.75.

A program to analyze, design, fabricate, and test shutoff valves, check valves, and flow-control valves for LMFBR reactors is described. (DCC)

28016 (NDS-15) ISOLATION VALVE REQUIREMENTS ANALYSIS (PRELIMINARY) SODIUM VALVE TECHNOLOGY PROGRAM. Dever, J. E.; Price, D. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). 22 Apr 1969. 19p. Dep. NTIS $4.00.

Design and performance requirements for LMFBR isolation valves in the primary and secondary sodium loops are presented. (auth)

28017 (NPS-681114(Vol.1)) DEVELOPMENT OF LIQUID METAL FAST BREEDER REACTOR VALVE TECHNOLOGY. Volume I. Technical Approach and Program. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1968. 401p. Dep. NTIS $23.25.

Information on the development of LMFBR valves is presented concerning design, manufacturing, problem areas and solutions, stress analysis, thermal analysis, materials, company organization and interest, facilities available, manufacturing procedures and quality assurance, liquid metal technology, and company personnel. (DCC)

28018 (ORNL-TM-4714) STATE-OF-THE-ART REVIEW OF EQUIPMENT CELL LINERS FOR LMFBRs. Chapman, R. H. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 88p. Dep. NTIS $5.45.

Cell liner design concepts and practices used in liquid-metal-cooled fast breeder reactor (LMFBR) systems were surveyed to ascertain the manner by which the functional requirements were satisfied, the severity of sodium spills the liners were designed to accommodate, and the problems encountered in design and construction. The survey was limited to "loop-type" LMFBRs, with primary interest on recently constructed plants. The report discusses steel-lined concrete structures; describes cell liner designs used in several LMFBR plants, with particular emphasis on the Southwest Experimental Fast Oxide Reactor (SEFOR) and the Fast Flux Test Facility (FFTF); and identifies research and development believed necessary to permit a rational and thorough assessment of cell liner design concepts. (84 references) (auth)

28019 (WARD-OX-3045-15) OXIDE FUEL ELEMENT DEVELOPMENT. Quarterly Progress Report for Period Ending September 30, 1974. Boltax, A.; Saling, J. H. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jan 1975. Contract AT(11-1)-3045. 69p. AT.

Progress is reported in the following areas: (1) coordination and evaluation of mixed-oxide irradiation tests, (2) post-irradiation examination of fast reactor fuel pins, (3) LMFBR grid-type fuel assembly design, (4) fabrication, development, and testing of LMFBR fuel assemblies, (5) evaluation and analysis of fuel and cladding irradiation behavior, and (6) improvement of analytical methods and lifetime codes. Stress-rupture data are presented for Type 316 stainless steel. (DG)

28020 REACTOR PHYSICS CALCULATIONAL METHODS IN SUPPORT OF THE PROTOTYPE FAST REACTOR. Wardleworth, D.; Wheeler, R. C. (United Kingdom Atomic Energy Authority, Dounreay, Eng.). J. Brit. Nucl. Energy Soc.; 13: No. 4, 383-390(Oct 1974).

The introduction of systematic data handling has significantly improved the calculational support for the PFR, and further improvements based on the COSMOS system are envisaged. Examples of PFR calculation support are given. The time delay between loading new cores and the associated diffusion theory calculations has been reduced. The increased efficiency in handling the large quantities of data necessary to describe a large core will have an even greater importance to later reactors such as CFR, particularly in the optimization of fuel management plans. (auth)

28021 NUCLEAR POWER. Speeding up Britain's Fast Reactor. Engineer; 239: No. 6192, 40-41(14 Nov 1974).

The importance of making fast reactors commercially available for service from the 1990s onwards is considered essential in order to safeguard uranium prices. A 1300 MW demonstration plant is suggested as the next stage. This will be of the same general design as PFR with various modifications. Useful experience was gained during the commissioning of the PFR. Reference is made to repair of two pump failures and minor leaks. More recent delays in commissioning, however, were caused by faults in conventional equipment. (UK)

28022 LMFBR INTERMEDIATE HEAT EXCHANGER. Creek, R. B. (to Combustion Engineering Inc.). US Patent 3,850,231. 26 Nov 1974. Filed date 24 May 1973. 6p.

A heat exchanger of the shell and tube type and particularly adapted to employ liquid metal as the heating fluid is provided with a floating head for connecting the ends of the heat exchanger tubes whereby stresses on the tubes due to thermally induced differential movements between the tubes and the shell are prevented. A pair of mutually spaced expansion bellows are connected between the floating head and the shell to define a closed space within which an inert gas is maintained. The bellows pair provides a double barrier between the heating fluid and the fluid to be heated to prevent admixture of the two fluids while the inert gas space intermediate the bellows provides means for detecting a bellows failure enabling the ruptured bellows to be replaced without danger of mixing the two fluids. (Official Gazette)

28023 ENERGY SOURCE OF THE FUTURE: THE FAST BREEDER REACTOR OR ? Foell, W. K. (Univ. of Wisconsin, Madison). pp 107-140 of Energy and the Environment. Efford, I. E. (ed.). Vancouver, B. C.; Univ. of British Columbia (1972).

The evolution of man's energy usage is discussed in terms of exploration, extraction, processing, transport, and conversion. Fossil fuels are discussed in this context, and the breeder reactor's impact on extraction needs is emphasized. The status of fusion reactor research is reviewed and the relative merits of fusion and breeder reactors are exhaustively compared. End uses and conversion of energy are examined and the need for energy conservation measures stressed. (CA)

28024 GAS IN PLACE OF METAL. Krasin, A. (Inst. of Nuclear Energy, Minsk). J. Inst. Nucl. Eng.; 15: No. 5, 152 (Sep 1974).

A new type of fast breeder reactor is described that is under development at the Byelorussian Academy of Sciences Institute of Nuclear Engineering. The reactor is gas cooled, and advantages of using gas instead of liquid metal are outlined. The gas employed is N_2O_4, which owes its special features to what is termed "dissociation capacity". On heating to 500° to 600°C the gas molecules dissociate, first into two dioxide molecules and then into three molecules, with absorption of a large amount of heat. If the gas is then cooled down the molecules reform the

initial N_2O_4, with release of heat. It is stated that the use of this dissociating gas makes it possible to remove heat from the reactor far more vigorously and effectively. Furthermore, the thermal and physical properties of the gas make it possible to supply directly to a turbine and to obtain a superior turbine efficiency. The reactor also gives a high nuclear fuel conversion ratio and a low doubling time, and should be reasonably compact and easily transportable. (UK)

28025 250-MW PROTOTYPE FAST REACTOR. Heat. Air Cond. J.; 44: No. 517, 20-24(Dec 1974).

An account is given of recent developments and final commissioning stages of the Prototype Fast Reactor at Dounreay, Scotland. Included are PFR specifications and brief descriptions of the major components. (DG)

28026 PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON PHYSICS OF FAST REACTORS, TOKYO, JAPAN, OCTOBER 16–19, 1973. Volume I. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973). 616p. (CONF-731015-P1).

Separate abstracts are included for 7 of the 28 papers presented concerning the review of national fast reactor programs, physics experiments with reactors, and experiments with critical facilities, twenty-one of the papers have previously been abstracted and can be found in NSA under the following abstract numbers: 31: 07563; 31: 07564; 31: 07566; 31: 07565; 31: 07567; 31: 07568; 31: 07569; 31: 07582; 31: 07583; 31: 07586; 31: 07584; 31: 07587; 31: 07887; 31: 07589; 31: 07588; 31: 07570; 31: 07571; 31: 07572; 31: 07826; 31: 07674; and 31: 07592. (DCC)

For abstracts of individual papers see: 28027–28030 and 28069–28071.

28027 RETRIEVAL OF REACTIVITY COEFFICIENTS FROM EFFBR ON-LINE OPERATING DATA. Stievenart, M.; Bouffioux, P. (Belgonucleaire, S. A., Brussels). pp 139-151 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. I. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P1.

The Enrico Fermi Fast Breeder Reactor (EFFBR) has been practically the only reactor equipped with a process computer capable of checking on-line the reactivity balance. Some available on-line measurements were used to test off-line methods of retrieval of reactivity coefficients with the scope of evaluating the possibility of updating the reactivity coefficients in on-line reactivity balance monitoring. Several methods were used successfully and yielded several sets of EFFBR reactivity coefficients, the differences are discussed. A comparison of these coefficients with values obtained by standard techniques was also performed and the disagreements are discussed. 6 references. (auth)

28028 INVESTIGATION OF THE BN-350 REACTOR PHYSICAL CHARACTERISTICS. Orlov, V. V.; Pomerantsev, G. B.; Yurchenko, D. S. (State Committee for Utilization of Atomic Energy, Moscow). pp 240-255 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. I. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P1.

Experimental results for static physical characteristics of the BN-350 fast power reactor are given. The reactor reached criticality on November 29, 1972. The experimental data obtained are compared with theoretical results. 12 references. (auth)

28029 USE OF INTEGRAL EXPERIMENTS TO IMPROVE NEUTRON PROPAGATION AND GAMMA HEATING CALCULATIONS. Oceraies, Y. (CEN de Caderache, St.-Paul-les-Durance, France); Caumette, P.; Devillers, C.; Bussac, J. pp 486-505 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. I. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P1.

The studies to define and improve the accuracy of neutron propagation and gamma heating calculations from integral experiments are encompassed in the field of the fast reactor physics program at CEA. A systematic analysis of neutron propagation in Fe–Na clean media, with variable volumic composition between 0 and 100% in sodium, has been performed on the HARMONITE source reactor. Gamma heating traverses in the core, the blankets and several control rods, have been measured in the RZ core program at MASURCA. The experimental techniques, the accuracies and the results obtained are given. The approximations of the calculational methods used to analyze these experiments and to predict the corresponding design parameters are also described. Particular emphasis is given to the methods planned to improve fundamental data used in neutron propagation calculations, using the discrepancies observed between measured and calculated results in clean integral experiments. One of these approaches, similar to the techniques used in core physics, relies upon sensitivity studies and eventually on adjustment techniques applied to neutron propagation. 13 references. (auth)

28030 RECENT PROGRESS IN FAST INTEGRAL EXPERIMENT AND ANALYSIS AT FCA. Hirota, J.; Kurol, H.; Iijima, T.; Mizoo, N.; Shirakata, K. (Atomic Energy Research Inst., Ibaraki, Japan). pp 506-519 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. I. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P1.

A series of mock-up experiments for the Prototype Fast Breeder Reactor MONJU were started at FCA in August 1972. Two assemblies of zoned loading, named VI-1 and VI-2, have been constructed as the physics mock-up; the composition of the test reaction of Assembly VI-1 and VI-2 are simulated to that of the outer core and the inner core of MONJU respectively. On these two assemblies, a study of the criticality has been made including the heterogeneity effect due to the plate structure. The full mock-up experiments for MONJU were carried out at ZEBRA under the collaboration between the UKAEA and PNC; MZ-A, MZ-B, and MZ-C. A study is now being progressed of the correlation between integral data obtained on the partial and full mock-up systems; Assembly VI-1, VI-2, and MZ-A, MZ-B. The code system DOYC with AGLI is used throughout the analysis. The two dimensional S_n or diffusion approximation is used depending on either essential space dependence or energy dependence. This study shows how the result obtained on the partial mock-up system contributes to improvement of the reliability of predictions for large fast reactors. 6 references. (auth)

28031 PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON PHYSICS OF FAST REACTORS, TOKYO, JAPAN, OCTOBER 16–19, 1973. Volume II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973). 516p. (CONF-731015-P2).

Separate abstracts are included for 10 of the 25 papers presented concerning nuclear data, numerical and analytical methods, neutron spectrum and reactivity coefficients, and experiments with critical facilities. Fifteen of the papers have been previously abstracted and can be found in NSA under the following abstract numbers: 31: 07814; 31: 07574; 31: 07594; 31: 07820; 31: 07821; 31: 07577; 31: 07578; 31: 07579; 31: 07672; 31: 07676; 31: 07596; 31: 07575; 31: 07888; 31: 07677; and 31: 07817. (DCC)

For abstracts of individual papers see: 28032–28035, 28072–28074, and 28727–28729.

28032 THREE-DIMENSIONAL BURN-UP CALCULATION IN FAST REACTORS. Takeda, S.; Takeda, R.; Kobayashi, T. (Hitachi Ltd., Kanagawa, Japan). pp 745-766 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P2.

In order to predict accurately the burnup characteristics of reactors on operation and evaluate the economical and safety features, it is necessary to develop the three-dimensional burnup calculation program. A few programs have been already developed but it is difficult to apply these programs for the actual fast breeder reactors because of the complexity of making the input data, limitation of the number of regions and long computational time. As the main objective of the three-dimensional burnup calculation is to analyze the space dependent phenomena in the reactor in detail, it is necessary to treat the fine space dependent group constants and number densities of the nuclides. A new program which needs only the fuel assembly configuration, namely, the space dependent number density of the nuclides as the input data has been developed. The approach to develop the program and the calculated results and discussions will be given. 6 references. (auth)

28033 ASSESSMENT OF FAST REACTOR GROUP CONSTANTS FOR SOME REACTOR MATERIALS THROUGH MEASUREMENTS AND ANALYSES OF ENERGY- AND SPACE-DISTRIBUTIONS OF FAST NEUTRONS IN TEST ASSEMBLIES. Nishihara, H.; Kimura, I. (Kyoto Univ.). pp 861-882 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P2.

Fast neutron spectra in iron, alumina and thoria have been mea-

sured by the neutron time-of-flight method using a linear accelerator as a pulsed neutron source. Along with the time-of-flight (TOF) runs, space distributions of neutrons and X-rays were measured by activation of nickel wires and gold foils. The total length of the flight path was 22.1 m. A bank of three ^{6}Li-glass scintillation counters (NE 912 + EMI 9618 R, 12.7 cm diameter) was mainly used for neutron detection. A liquid scintillation counter (NE 213) and a boron-vaseline counter were also used. A new type high-speed multi-channel time-analyzer with wire-memories has been developed for the fast neutron TOF analyses. The space-, energy- and angular-distributions of neutrons in test assemblies were calculated using the multi-group S_n code DTF-IV, assuming spherically symmetric geometries. This assumption has been verified by the spherical symmetry observed in spatial distributions of neutron flux. The scattering is assumed to be linearly anisotropic (P_1 approximation). The group constants were mostly taken from the JAERI-FAST SET (J-F) and the ABBN SET (ABBN). Group constants for thorium, which are not included in J-F, have been generated from ENDF/B-2 data (J-M). A new set of group constants for iron (J-E) was also used as input to DTF-IV. This set was generated at JAERI using the exact spectrum by the code ESELEM-IV as the weighting spectrum. 20 references. (auth)

28034 MEASUREMENTS OF FAST NEUTRON SPECTRA IN IRON, URANIUM, AND SODIUM–IRON ASSEMBLIES. Kappler, F.; Pieroni, N.; Rusch, D.; Schmidt, A.; Wattecamps, E.; Werle, H. (Kernforschungszentrum, Karlsruhe, Ger.). pp 883-907 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P2.

Spectrum measurements were performed at the fast subcritical facility SUAK to test nuclear data and computer codes used in fast reactor calculations. In order to obtain a specific and quantitative interpretation of discrepancies between measured and calculated spectrum, homogeneous assemblies consisting of single materials were investigated. The leakage spectrum of iron and uranium cylinders was measured by time-of-flight and proportional counters. Time-dependent leakage spectra were measured by a NE 213 liquid scintillator. It was demonstrated that the investigation of time-dependent spectra is a sensitive test of inelastic scattering cross section data. The effect of an interface on fast neutron spectra was also investigated by measuring space dependent spectra across a sodium–iron interface. The measured spectra of these assemblies are suitable for testing the adequacy of computational approximations and cross section data. 21 references. (auth)

28035 MEASUREMENTS AND ANALYSIS OF THE DOPPLER EFFECT OF STRUCTURAL MATERIALS. Ishiguro, Y.; Mukaiyama, T.; Iijima, T.; Takano, H. (Japan Atomic Energy Research Inst., Ibaraki). pp 964-983 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P2.

The Doppler effect of structural materials has been studied at JAERI and the importance in fast reactor safety has been emphasized. The summary of the study is presented. The new Doppler experiment of the structural materials was performed in FCA Assembly VI-1 constructed for the purpose of the MONJU mockup. The method used is based on measuring the reactivity changes which result from heating a small Doppler sample. By oscillating the sample and the reference material to be placed at the core center alternatively, the reactivity drift is eliminated and a precision of 10^{-7} $\Delta k/k$ is achieved when the reactivity changes are determined. This experimental result shows that the Doppler effect due to the structural materials is much larger, compared with those formerly observed in the smaller FCA cores. The Doppler experimental result was analyzed by a simple perturbation method based on the two-dimensional diffusion theory. In this analysis, three sets of the resonance shielding factors were used for the effective capture cross sections of Cr, Fe, and Ni. These sets are based on the nuclear data of ENDF/B-II and -III and the resonance parameters evaluated by Story. The obtained results are not always in good agreement with the experimental result, and moreover there are considerable differences among the calculated values. 17 references. (auth)

28036 PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON PHYSICS OF FAST REACTORS, TOKYO, JAPAN, OCTOBER 16–19, 1973. Volume III. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973). 464p. (CONF-731015-P3).

Separate abstracts are included for 3 of the 23 papers presented concerning the development of data collections and reactor design problems. Twenty of the papers have previously been abstracted and can be found in NSA under the following abstract numbers: 31: 07824; 31: 07598; 31: 07823; 31: 07599; 31: 07890; 31: 07889; 31: 07891; 31: 07745; 31: 07678; 31: 07600; 29: 20078; 31: 07601; 31: 07602; 31: 07827; 29: 07190; 31: 07603; 31: 07604; 31: 07828; 31: 07828; 31: 07829; and 31: 07605. (DCC)

For abstracts of individual papers see: 28684, 28730, and 28731.

28037 FAST REACTOR POWER STATIONS. Proceedings of the International Conference Organized by the British Nuclear Energy Society Held on 11–14 March 1974 at the Institution of Civil Engineers, London. London; British Nuclear Energy Society (1974). 675p. (CONF-740318-).

Separate abstracts are included for 2 of the 62 papers presented concerning experience with large power plants, planned power plants, steam generators, nuclear performance, core including fuel, control dynamics and hydraulics, coolant management, fuel handling and other mechanisms, and future plans. Sixty of the papers have previously been abstracted and can be found in NSA under the following abstract numbers: 31: 05212; 31: 13194–31: 13225; 31: 13228; 31: 13230–31: 13247; 31: 13269–31: 13274; 31: 13299; and 31: 13388. (DCC)

For abstracts of individual papers see: 28038 and 28685.

28038 DESIGN, CONSTRUCTION, AND COMMISSIONING OF PFR AS OF 14 DECEMBER, 1973. Evans, A. D.; Laithwaite, J. M.; Nunn, D. A. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 1-11 of Fast Reactor Power Stations. London; British Nuclear Energy Society (1974).

From conference on fast reactor power stations; London, UK (11 Mar 1974). See CONF-740318-.

The first part of the commissioning programme and a brief review of the final stages of construction are presented. Critical path planning was used extensively throughout the design, supply, construction and testing stages to provide the best possible cost and programme control. In general the primary circuit construction activities set the critical path. (auth)

28039 THE SYSTEM OF GAS COOLED FAST BREEDER REACTORS: COMPETITIVE ENERGY WITH BREEDING. Ind. At. Spatiales; 18: No. 3, 33-43(May 1974). (In French).

This paper is from the European Association for G.B.R. (Gas-cooled Breeder Reactor) Brussels and will be published in Atomwirtschaf Energia Nucleare and Nuclear Engineering in agreement with the members of the Europressatom group.

The GBR-4 reactor is described. This reactor is used as a reference for economic, safety, research, and development studies on fast gas-cooled reactors and as a guide for the definition of a demonstration reactor. It uses pin type fuel and is helium-cooled. The main specifications are given for two versions of a 1200 MW(e) station of this kind. The economic aspects and development possibilities of such reactors are discussed. (FR)

28040 THE FRENCH FAST BREEDER REACTOR PROGRAM. Crette, J. P. (Groupement pour les Activites Atomiques et Avancees (GAAA), 92–Le Plessis-Robinson (France)); Megy, J. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 75–Paris (France)). Kerntechnik; 16: No. 11, 481-483(Nov 1974).

3 figs.; 1 ref.

The importance of fast breeder reactors is discussed in view of the recent events on the energy market. The Phenix and Super-Phenix systems are described. The participation of the French Commissariat a l'Energie Atomique and of French industrial firms in both projects is examined in detail. (auth)

28041 GBR-4: CONCEPT OF A 1,200 MWe-GAS BREEDER NUCLEAR POWER STATION. P. 2. A Study Concerned with Safety and Economics of the GBR. Chermanne, J. (European Association for Gas-Cooled Breeder Reactor (GBR), Brussels (Belgium)). Atomwirt., Atomtech.; 19: No. 11, 540-542(Nov 1974). (In German).

5 figs.; 6 refs.

Economics, development potential, and suggestions for further GBR development are examined. (GE)

28042 RESTRAINTS AND ANCHORS FOR BREEDER REACTOR SODIUM COOLANT PIPING. Reis, E. (Atomics International, Canoga Park, CA); Van Meter, W. Heat., Piping Air Cond.; 46: No. 12, 58-63(Nov 1974).

Design considerations are discussed for pipe restraints and anchors to accommodate sodium-water reaction pressures and temperatures resulting from steam generator tube rupture in an LMFBR. (auth)

28043 DEMONSTRATION LMFBR: PROGRESS AND PROBLEMS. Olds, F. C. (ed.). Power Eng.; 78: No. 12, 26-33(Dec 1974).

The status of the Clinch River Breeder Reactor is reviewed, and problems due to cost escalations and environmental questions are discussed. Cost data are presented and cost benefit projections are made. Foreign and U. S. activities in the liquid metal cooled reactor field are briefly reviewed. (DG)

Research, Test, and Experimental Reactors

Refer also to abstracts 27601, 28003, 28030, 28034, 28035, 28678, 28712, 28779, 28780, 28782, and 28783.

28044 (AGC-2514) FINAL TEST SPECIFICATIONS FOR GROUND TEST REACTOR (GTR) TESTS OF 20 APRIL 1963. (Aerojet-General Corp., Azusa, Calif. (USA)). 1963. 140p. Dep. NTIS $10.00.

Detailed specifications are provided for irradiation effects tests of electronic equipment, measuring instruments, bearings, etc. at cryrogenic conditions. In most cases the equipment is to be operating during the irradiation. (LTN)

28045 (AGC-2573) PROGRAM PLANNING DETAILS FOR GENERAL DYNAMICS/FORT WORTH. (Aerojet-General Corp., Azusa, Calif. (USA)). 22 May 1963. 35p. Dep. NTIS $4.75.

28046 (ANL-CT-75-22) PREDICTION OF FLOW INDUCED VIBRATION OF THE HCM/FTR OPEN TEST ASSEMBLY. Turula, P. (Argonne National Lab., Ill. (USA)). Dec 1974. Contract W-31-109-eng-38. 46p. AT.

Analytical methods for predicting vibration behavior of structural components subjected to a flow have been developed and used to predict the flow induced vibration response of selected upper plenum components tested in the Hydraulic Core Mockup (HCM) of the Fast Test Reactor (FTR). The vibration analysis is carried out using the NASTRAN program and auxiliary programs developed as needed. It consists of modal analysis (computation of natural vibration frequencies and mode shapes) and response analysis (computation of vibration amplitudes associated with harmonic loadings applied over a range of frequencies). Comparisons with available experimental results are made. The technique of remote measurement of vibrations at inaccessible points inside the reactor, using data from sensors located on accessible points outside, is considered. (6 references) (auth)

28047 (ANSC-BLT-14-A782) CONCEPTUAL DESIGN REQUIREMENTS; IRRADIATED-FUEL-HANDLING BOTTOM-LOADING TRANSFER CASK FOR THE FAST-FLUX TEST FACILITY, HANFORD WORKS, RICHLAND, WASHINGTON. (Aerojet Nuclear Systems Co., Azusa, Calif. (USA)). Dec 1970. Contract AT(04-3)-782. 23p. Dep. NTIS $4.25.

The design requirements applicable to the conceptual design of the Bottom Loading Transfer Cask (BLTC) and its associated transporter to be used in the transfer of core components at the Fast Flux Test Facility (FFTF) are presented. (auth)

28048 (CONF-7209124-, pp 348-356) COMPARISON BETWEEN TRANSPORT AND DIFFUSION CALCULATIONS FOR THE VVR-S LATTICE CELL. Boeriu, S.; Cepraga, D.; Cristian, I.; Gheorghiu, E. (Inst. of Nuclear Technologies, Bucharest). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

A comparison of the DACC-1 and THERMOS codes for calculating the kinetics of the WWR-C-Bucharest reactor is presented. (DCC)

28049 (GA-9555) PRELIMINARY DESIGN AND ANALYSIS OF THE THERMIONIC REACTOR EXPERIMENT CORE. Allen, D. T.; Fisher, C. R.; Gietzen, A. J.; Homeyer, W. G. (Gulf General Atomic Co., San Diego, Calif. (USA)). 20 Jul 1970. Contract AT(04-3)-167. 85p. Dep. NTIS $7.25.

Declassified 4 Mar 1975.

The design of the core of the Thermionic Reactor Experiment is based upon the simulation of the core of a 100 kW(e) flight reactor with the additional requirement of fuel element removability. A conceptual reference core design has been established. This design has been subjected to analysis of its predicted operating characteristics to establish its validity and practicality. This work has included analysis of temperature distributions in the fuel elements and the resulting thermal stresses, fission product gas management, study of the effects of blocked and partially blocked coolant channels, the effects of fuel element bowing, the potential for flow-induced fuel element vibration, fuel element removability, and reactivity coefficients for coolant temperature changes. The results of these studies are given. They indicate that the core design is adequate in every respect, but that additional work is required to evaluate flow-induced fuel element vibrations. (23 references) (auth)

28050 (HEDL-TME-74-62) LONG-TERM TESTS OF SILICA-INSULATED CABLE UNDER FFTF EX-VESSEL TEMPERATURE AND VOLTAGE CONDITIONS. Philipp, L. C.; Muhlestein, L. D.; Cannon, C. P. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 15 Oct 1974. Contract AT(45-1)-2170. 43p. AT.

A metal-sheathed, silica-insulated instrument cable was long-term tested with both positive and negative high voltage. Periodic measurements of resistance, capacitance, characteristic impedance, and breakdown pulse noise were recorded. Based on the test results, this type of cable, with minor modification, will be acceptable for the FFTF ex-vessel neutron flux monitoring system. (auth)

28051 (IEA-TI-23) REACTOR IRRADIATIONS AND ACTIVATION CALCULATIONS. Penteado, F. (Instituto de Energia Atomica, Sao Paulo (Brazil). Divisao de Operacao e Manutencao de Reatores). Nov 1972. 51p. (In Portuguese). INIS.

Methods of reactor induced activation calculations are presented. The calculation methods involve continuous and intermittent irradiations. The most frequent irradiations at the IEAR-1 reactor are emphasized. Besides the activation calculations several other aspects related to the irradiations are considered. In order to facilitate the choice of the irradiation targets, some aspects that could influence the irradiation safety and efficiency are mentioned. Some phenomena that affect the irradiation facilities and reactor safety are considered. The induced parisitic activities in the sample and capsules or vials are considered. The effects of parallel activations, secondary activations, second order activations, and the formation of elements genetically related are considered. Some factors such as neutron flux variations and total flux perturbation are mentioned. The importance of the burnup of high cross section isotopes during irradiation is evident. Graphs and formulas to facilitate the activation calculations and the characteristics required for the targets most suitable for the irradiations are presented. (INIS)

28052 (INIS-mf-1276) DESIGN OF A HIGH RESOLUTION SYSTEM FOR NEUTRON RADIOGRAPHY. Jimenez, R. W. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias). 1973. 91p. (In Spanish). INIS.

Thesis.

A neutron radiography system was designed and constructed in a tangential rod tube of the TRIGA MARK III reactor of the Mexican Nuclear Center. Measurements of the thermal flux were first made in various tubes to determine the one most suitable for the system. γ dosimetric measurements and thermal flux measurements by activation methods and with a BF_3 proportional detector were also made. The dimensions of the divergent collimator to be used as a neutron reflector were optimized experimentally. The results were considered satisfactory with respect to resolution. (tr-auth)

28053 (IRI-Int-131-73-01) POWER DISTRIBUTION, MAXIMUM HEAT FLUX, AND CRITICAL HEAT FLUX. Rijks, H. J. (Interuniversitair Reactor Instituut, Delft (Netherlands)). Jan 1972. 10p. (In Dutch). INIS.

Due to the change of the core configuration of the HOR reactor, the maximum heat flux is determined with the aid of neutron flux measurements, and the critical heat flux, taking into account the clearances of the used two types of fuel elements, and the coolant velocity are calculated. It is concluded that the safety margin at 2 MW operation, using the two types of fuel elements, is large enough. (auth)

28054 (JAERI-M-5730) PHYSICS AND NUCLEAR ANALYSIS OF THE NUCLEAR SAFETY RESEARCH REACTOR. I. Thermal Neutron Spectrum, Prompt Negative Temperature Coefficients, and Kinetics Parameters of the NSRR. Ise, T.; Nakahara, Y.; Akimoto, M. (Japan Atomic Energy Research Inst., Tokyo). Jun 1974. 52p. (In Japanese). Dep. NTIS (US Sales Only).

The NSRR is a kind of solid homogeneous reactor. Accordingly the reactor has the large prompt negative temperature coefficient. In addition the coefficient is much larger than that of other reactors, since the fuel itself contains a large amount of hydrogen in the form of zirconium hydride, which has a strong moderating ability. As a result of an extensive numerical analysis of the characteristics of this reactor, the calculational procedure for the nuclear design and the physical properties is derived. (auth)

28055 (JAERI-M-5802) COMPUTER SYSTEM FOR AUTOMATIC RADIATION MEASUREMENT IN THE JMTR. Terada, H.; Kanbara, M.; Kondo, I.; Nomura, M. (Japan Atomic Energy Research Inst., Tokyo). Aug 1974. 43p. (In Japanese). Dep. NTIS (US Sales Only).

A computer system has been introduced to perform routine works of radiation measurement of activation foils irradiated in JMTR and JMTRC. The design and characteristics of the system are described. (auth)

28056 (JAERI-M-5827) RADIATION MONITORING OF THE JMTR PERFORMED FROM ITS OPERATIONAL TEST TO THE 20TH OPERATION CYCLE. (Japan Atomic Energy Research Inst., Tokyo). Aug 1974. 94p. (In Japanese). Dep. NTIS (US Sales Only).

The radiation monitoring system in the Japan Materials Testing Reactor (JMTR) and the results of monitoring from the operational test prior to routine operation to the 20th operation cycle are described. The JMTR is light-water moderated and cooled with highly enriched uranium as the fuel. The production of tritium in the primary coolant is also explained through calculation and measurement. (auth)

28057 (LA-5795-C, pp 124-135) STATUS OF NUCLEAR PROCESS HEAT DEVELOPMENT WORK IN THE DRAGON PROJECT. Hosegood, S. B. Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

A brief resumé of the role played by the Dragon Project in the development of the High Temperature Reactor for Electricity generation is presented. This leads on to a survey of the needs and timescale foreseen in the Dragon countries for development of Very High Temperature Reactors to supply high grade process heat for replacement of fossil fuels. International co-operation, using the experience and facilities of the Dragon Project, is seen as a powerful means for pursuing this development work. Some proposals for further investigation in both the design and materials fields are briefly outlined and the need for an early start to substantial programs of work is emphasized. (auth)

28058 (ND-681101) LMFBR FUEL-HANDLING-SYSTEM DESIGN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 29 Apr 1968. 552p. Dep. NTIS $30.75.

Aerojet-General Corporation submits this proposal in response to the Atomic Energy Commission's request for proposal (RFP) entitled "LMFBR-Fuel Handling System Design," dated 1 April 1968. This proposal is organized to respond to the specific selection criteria and prerequisites stated in the AEC transmittal cover letter and in direct response to the qualifications-instruction list, Enclosure VI, of the subject RFP. The primary objective of the program is to provide the capability for design, development, and testing of fuel-handling and radioactive maintenance systems for the AEC's Liquid Metal Fast Breeder Reactor (LMFBR) Program. The initial effort is directed to support the fuel-handling requirements of the AEC's Fast Flux Test Facility (FFTF) to be constructed at the Pacific Northwest Laboratory, Richland, Washington. (auth)

28059 (NDS-19) PROCEDURES AND RESULTS FOR SELECTION OF PROSPECTIVE EXHIBIT-C PRIMARY-VALVE CONCEPTS FOR PRELIMINARY DESIGN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Aug 1969. Contract AT(30-1)-4026. 76p. Dep. NTIS $7.00.

By means of rating sheets and a coordination and selection meeting, the most promising basic valve concepts were selected for the preliminary design phase of the FFTF (fast-flux test facility) MHTS (main-heat-transport system) sodium valves for the primary system. No concept met all the requirements. The rating data are shown. The success-failure history and the configurations and rating requirements for the valves are given. (auth)

28060 (RN-TM-0564) RESULTS OF NRX-A6 FLAME-SPRAY EVALUATION TEST. Fox, H. A. Jr. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 10 May 1968. 20p. Dep. NTIS $4.00.

The results of the NRX-A6 flame-spray tests are presented. The general objective was to determine the effectiveness of a flame-sprayed aluminum coating used to provide a thermal path between gamma-heated sheathed cables and the reactor pressure vessel. Of primary interest were the effects during the maximum-power steady-state period of EP-IIIB, when the heating rates were maximum. (auth)

28061 (TUBIK-35) PROMPT TEMPERATURE COEFFICIENT OF THE ZrH-MODERATED REACTOR CORE OF THE BER-2. Storck, R.; Memmert, G. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Kerntechnik). Sep 1974. 56p. (In German). Dep. NTIS (US Sales Only) $6.00.

Temperature coefficient calculations are presented for a critical core consisting of fourteen fuel elements with 58.5% control rod insertion. The leakage contribution at 350°K accounts for 53% of the total prompt temperature coefficient. (DG)

28062 (ZJE-129) OPTIMIZATION OF SHIELDING FOR THE ZRR FAST TESTING REACTOR. Fritz, Z.; Jechort, P.; Valenta, V.; Vlachovsky, K. (Skoda, Plzen (Czechoslovakia). Zavod Vystavba Jadernych Elektraren). 1972. 149p. INIS.

An optimization of the iron-graphite axial shielding and of the composition of the concrete radial shielding of the ZRR fast testing reactor is presented. The method of performing the optimization is described. (auth)

28063 DEVELOPMENT OF SODIUM INPILE LOOP. Fujii, I.; Ohno, M.; Takeahara, K. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). J. Brit. Nucl. Energy Soc.; 13: No. 4, 403-406(Oct 1974).

A sodium facility has been installed in the Toshiba training reactor for the purposes of development of a failed fuel detection system, and the study of radionuclides distribution and their clean-up. The facility comprises an inpile plug and associated sodium loop. Descriptions are given of the facility and of preliminary commissioning tests. (auth)

28064 A VERTICAL BEAM-TUBE FOR CONVERSION ELECTRON SPECTROSCOPY AT THE GRENOBLE HFR. Faudou, J. C.; Maier, B. P. K. (Institut Max von Laue-Paul Langevin, 38-Grenoble (France)). Kerntechnik; 16: No. 11, 496-499(Nov 1974).

A vertical beam tube for conversion electron spectroscopy has been constructed at the HFR ILL. The lower part of the beam tube being in contact with the heavy water is made of Zircalloy. The target for the production of conversion electrons is mounted within this tube at a distance of 79 cm from the centre of the reactor core. The measured neutron flux density at this position is about 3×10^{14} cm^{2} s^{-1}. A vertical tube enables the experimentalist to exchange the source even when the reactor is at full power. Another tube, inclined by 7° with respect to the vertical axis, serves as electron flight tube, the total length of which is about 15 m. The whole facility allows for a vacuum better than 10^{-5} Torr. The earth's magnetic field is partly shielded by means of μ-metal tubes inside the inclined tube and partly compensated by 4 Helmholtz wires in the surrounding light-water tank of the reactor. (auth)

28065 VENTILATION SYSTEM FOR THE HEAVY WATER MODERATED EXPERIMENTAL REACTOR AQUILON. Amadesi, P.; Cazzoli, S.; Cucchi, G.; Manzini, R. (CNEN, Bologna). G. Fis. Sanit. Prot. Radiaz.; 17: No. 3-4, 62-71(1973). (In Italian).

A ventilation and air conditioning system for the Aquilon reactor is described. The ventilation air flow rate was estimated keeping account of the maximum tritium content on the heavy water, of the maximum number of times that the D_2O container must be opened a day for operation needs, and also of the maximum temperature of D_2O. The inhalation dose of tritium in the reactor hall, concerning only the occupationally exposed men, was evaluated together with the dose to the population, due to the exhaust of D_2O vapour containing tritium through the stack. (auth)

28066 TOTAL INTERACTION CROSS SECTION OF NEUTRONS WITH MATERIALS IN NUCLEAR REACTORS. Egorov, Yu. A.; Pankrat'ev, Yu. V.; Tolstykh, V. D. Vop. Fiz. Zashch. Reaktorov; No. 6, 158-165(1974). (In Russian).

An experimental installation to measure the total interaction cross section of reactor materials is described. It uses as a neutron source a narrow neutron beam from a water-water research reactor. The possible sources of error in the measurement are examined. The spectra of non-scattered neutrons passing through various thicknesses of serpentine concrete are given as an example of the results attainable with the installation. The non-scattered neutron spectrum of Ti showed anomalies that possibly could be caused in uncertainties in the data of Σ_t (average cross section) for Ti. The studies planned with the installation are indicated. (13 references) (JSR)

28067 EXPERIMENTAL AND THEORETICAL STUDY OF THE SOURCE-SINK METHOD AS APPLIED TO A SUBCRITICAL, NATURAL URANIUM, HEAVY WATER LATTICE WITH CONTAINED ABSORBERS. Zadworski, Z. F. Toronto; Univ. of Toronto (1971). 180p.

Thesis.

Neutron fine-structure measurements on five different configurations of absorbing pencils, as well as reference-lattice

measurements, were carried out in the University of Toronto natural uranium, heavy water, sub-critical reactor. The sub-critical system consisted of cylindrical fuel bundles in heavy water as a moderator (D_2O) (sources and sinks) cylindrical cobalt pencils in D_2O (sinks) fed with two external neutron sources (point sources), the first one in D_2O and the second one in graphite under the reactor vessel. Neutron transport theory gave unsatisfactory results because an acceptable approximate form could not be adapted to the present system, so further calculations were carried out using the source-sink method. Because of the complexity of the sub-critical system the source-sink theory could not be applied in its existing form, and an extensive study of the subject was necessary. (CA)

28068 ADAPTATION OF MULTICHANNEL ANALYSER FOR DETERMINATION OF PROMPT NEUTRON DECAY CONSTANT, ROSSI α OF A FAST CRITICAL FACILITY. Patwardhan, P. K.; Misra, V. M.; Pasupathy, C. S.; Kumar, S. (Bhabha Atomic Research Centre, Bombay (India). Electronics Div.). Nucl. Instrum. Methods; 122: No. 3, 383-388(15 Dec 1974).

A multichannel analyzer has been suitably adapted for determining a prompt neutron decay constant, Rossi α of nuclear reactor systems. The system is intended, (a) for studying the fluctuations of counts obtained in a specific time interval, (b) for determining the time interval distribution between pairs of pulses, and (c) for measuring the probability of obtaining chain-related counts following a trigger count as a function of time. For carrying out these measurements the address and control logic of the multi-channel analyzer has been suitably modified. Preliminary measurements of α and the asymptotic prompt variance of the fast critical facility (PURNIMA) at Trombay have been carried out and have given useful data on neutron life time and associated parameters. Using random pulses, PDA (Probability Distribution Analysis) patterns were taken and values close to unity were obtained for the expression V/M. Measurements made using an in-core fission counter and a 2'' diameter boron counter in the copper reflector at the core periphery of PURNIMA yielded values of (48 ± 5) ns and (75 ± 6) ns for neutron lifetimes. This system was also used for studying the second moment of neutron counts to obtain power calibration and shim rod worth. (auth)

28069 PHYSICS EXPERIMENTS WITH YAYOI. An, S.; Tamura, T.; Furuhashi, A.; Wakabayashi, H. (Tokyo Univ.). pp 152-174 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. I. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P1.

The reactor has been stably operated with little troubles experienced. Operating experience and measured reactor characteristics are presented. Physics experiments include neutron dose and spectrum measurement in experimental holes and columns, kinetic parameters such as β/l and the temperature feedback coefficients. Reactivity worths of several materials and the kinetic behavior of the reactor operated in combination with the five kinds of pile oscillators were also measured. Several experiments using YAYOI as a fast neutron source have been performed including the buckling and spectrum measurement in natural uranium assembly, transmission of fast neutron through material layers and irradiation of semiconductors and high-polymers. A liquid helium cryogenic system for low temperature irradiation is in preparation. 7 references. (auth)

28070 EBR-2 PHYSICS EXPERIENCE. Meneghetti, D.; Leowenstein, W. B. (Argonne National Lab., IL). pp 175-199 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. I. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P1.

The physics analyses of EBR-II loadings, operations, modifications, tests, and of environmental characteristics of each subassembly require extensive usage of current methods of analyses and also development and innovation of techniques. This is due to the heterogeneous complexity of the system, the frequent loading changes, and the user need for detailed environmental characterization. Adaptation and utilization of two-dimensional discrete-transport methods have been extensively applied to both neutronics and gamma analyses of the heterogeneously-loaded EBR-II core loadings having both the former depleted-uranium-type blanket and the recently installed steel-rich reflector. These analyses require close coupling and iteration with appropriate thermal-hydraulic models. Analytical studies for specific environmental tailoring of neutron and gamma levels for particular experimental subassemblies have been made. A burnup and fluence history for the subassemblies in the EBR-II core and blanket regions has been underway, beginning with EBR-II Run No. 1. 41 references. (auth)

28071 EVALUATION OF FISSION SPECTRA AND CROSS SECTIONS BY ZERO-LEAKAGE CORE EXPERIMENTS. Iijima, T.; Mukaiyama, T. (Japan Atomic Energy Research Inst., Ibaraki). pp 520-536 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. I. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P1.

A series of unit k-infinity core experiments were performed in FCA of JAERI to obtain the information on the equivalence of ^{239}Pu to ^{235}U in fast reactors, and to examine the inelastic slowing down cross section of ^{238}U. Three assemblies were built. Each assembly consists of a test zone (about 44l) of nearly unit k-infinity, a 20% enriched uranium driver and a natural uranium blanket. Assembly IV-1 (first built in 1969 and rebuilt in 1972) is an all uranium system, and Assemblies IV-1-P, IV-1-P' have a plutonium/natural uranium test zone. Three assemblies are nearly the same from the viewpoint of the slowing down cross section in the main energy region of the neutron spectrum, since ^{238}U occupies the most part of the composition. The main difference between Assembly IV-1 and the latter two is the difference in the fissile material. Fission rate ratios and k-infinity values were measured to obtain knowledge of the fission spectra and cross sections important for the criticality. In order to evaluate the inelastic slowing down cross section of ^{238}U, neutron spectra were measured with various methods 13 references. (auth)

28072 ANALYSIS AND CORRELATION OF MEASUREMENTS ON SNEAK AND ZPR VI FAST ASSEMBLIES BY THE ENDF/B VERSION 3 CROSS-SECTION DATA FILE. Gandini, A.; Petilli, M.; Salvatores, M. (CNEN, Casaccia, Italy). pp 629-644 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P2.

Estimates of group cross-sections are obtained by adopting a correlation method based on statistical theory. The numerical calculations have been performed by the AMARA and MARA correlation codes, the first one making use of the Lagrange multipliers technique for consistently reducing the computer running time, the second one adopting the method of reduction by elements and necessary when systematic errors within the cross-sections are allowed for. The starting data are represented by integral experiments obtained on the SNEAK (assemblies 7A and 7B) and ZPR VI (assembly 7) Pu-fueled fast critical facilities and by the ENDF/B (version 3) cross-section data files. The integral experiments considered are the following: K_{eff}, U-238 capture and fission and U-235 fission to Pu-239 fission rate ratios. The main differential parameters involved, as resulting from a sensitivity study, resulted to be: U-238 fission, capture and inelastic cross-sections, U-235 fission cross-section and Pu-239 fission cross-section and prompt fission spectrum. The resulting optimized cross-section set should be applicable to a large range of fast reactors, since the experiments involved in the correlation procedure representative of large diluted cores (ZPR VI assembly 7) and medium size cores (SNEAK assemblies). An unfavorable χ^2 test seems to indicate the probable presence of inaccurate assessments of the initial error estimates. A few calculational checks have indicated however that this fact should not reduce the significance of the trends associated with the results. 23 references. (auth)

28073 EXPERIENCES WITH STEK: DERIVATION OF FISSION PRODUCT CROSS SECTIONS AND THEIR IMPROVEMENT BY STATISTICAL ADJUSTMENT USING SAMPLE REACTIVITY WORTHS. Bustraan, M.; Dragt, J. B.; Gruppelaar, H.; Heyboer, R. J.; Janssen, A. J.; Lautenbach, G.; Smit, J.; Veenema, J. J. (Reactor Centrum Nederland, Petten). pp 665-682 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P2.

Reactivity worth measurements have been performed in the coupled fast-thermal critical facility STEK, with the aim to check and improve fission product group cross sections for fast breeders. Mixtures of fission products as well as isotopic samples have been oscillated in the central fast zone of STEK. Measurements in four different fast neutron spectra, corresponding to $C/^{235}U$ atomic ratios of 72, 47, 35 and 23, have been completed. The existing fission product capture cross section sets are reviewed. The present study is mainly based on the 26 group RCN-1 set for 75 fission product isotopes. Statistical errors in the group cross sections and their correla-

tions have been calculated, using as basis uncertainties in resonance parameters, nuclear level statistics and nuclear model errors. This error calculation is needed for the adjustment calculations. Results of measurements and calculations are presented. Resulting accuracies of fission product effects in SNR-300 are given. The pseudo fission product cross sections based on the RCN-1 set as presented in the report are recommended for fast reactor calculations. 17 references. (auth)

28074 ANALYSIS OF DOPPLER EXPERIMENTS. Matsuno, Y.; Yoshida, T.; Iijima, S.; Kamei, T. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Japan). pp 984-1004 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P2.

In the nuclear design of JOYO reactor, the design value of Doppler reactivity was determined by applying the bias factor (E/C) to the calculated value. The bias factor, 0.93 ± 0.20, has been determined from the analysis of the sample Doppler experiments performed on JOYO mockup assemblies at FCA. The results of analysis of Doppler experiments on SEFOR Core-I, SEFOR mockup and JOYO mockup are presented. These are applied to re-evaluate the JOYO value of Doppler reactivity. The calculations employed here were based on the two dimensional diffusion approximation and the first-order perturbation theory. The cross section set used was the NAIG Nuclear Set No. 5 (NNS-5) which had been used for JOYO design work. In this analysis, the Doppler effect of the structural material was taken into consideration that had been so far ignored usually. The resultant C/E values were 1.06 ± 0.04 and 0.98 ± 0.04 for ZPR-3-47 and FCA-V-1, respectively. That of SEFOR was 1.00 ± 0.10. From the constancy and the consistency of these C/E values, the bias factor to be applied to JOYO design was re-evaluated as 1.02 ± 0.20. This value fulfills, including the value of uncertainty, the required design accuracy of JOYO. 12 references. (auth)

28075 EBR-I INCIDENT: A REEXAMINATION. Lellouche, G. S. (Brookhaven National Laboratory, Upton, NY). Nucl. Sci. Eng.; 56: No. 3, 303-307(Mar 1975).

A reanalysis of the Experimental Breeder Reactor-I meltdown shows that far better agreement with experiment is obtained by the assumption that the coolant feedback coefficient operating during the later stages of the transient is positive and unstabilizing. A possible reason for such an occurrence is suggested. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 25972 and 27992.

28076 (EUR-4913) CONDITIONS OF OPERATION OF MULTIPURPOSE NUCLEAR PLANTS: ELECTRIC POWER/STEAM AND ELECTRIC POWER/DESALINATION. Technical and Economic Considerations. Biondi, L.; Vaudo, A. (Commission of the European Communities, Brussels (Belgium)). 1972. 92p. INIS.

The lively interest aroused among various industries by applications of nuclear energy other than for the purpose of generating electricity, notably within the chemical and steel industries, has given rise to an analytical study of the conditions for the operation of multipurpose nuclear power plants in the case of electrical power/steam and electrical power/desalination. The study covered the following: (1) a determination of typical zones of development and an examination of the requirements: curves for water, electrical power and industrial steam; (2) the compilation of a general mathematical study in order to calculate the unit cost of the steam used in the alternative applications of nuclear power plants; (3) the determination of the most rational dimensions for a multipurpose plant as a function of the characteristics for a given region; (4) the determination of the uses likely to affect the shape of the requirement curves of the electrical power and heat for industrial applications or desalination, with a view to adapting them of the optimum operating conditions of the plant. (INIS)

28077 (NUS-1277) PLUTONIUM-238 PRODUCTION IN COMMERCIAL WATER REACTORS EXPERIMENTAL AND ANALYTICAL PROGRAM. Report for the Period, July 1, 1973-September 30, 1974. Roach, K. E.; Turner, S. E.; Mitchell, W. III; Gurley, M. D. (NUS Corp., Dunedin, Fla. (USA). Southern Nuclear Dept.). Sep 1974 Contract AT(11-1)-2322. 123p. Dep. NTIS $5.45.

Activities reported include: (1) development of a simplified three-dimensional model, (2) correlation of experimental data and predictions, (3) target pellet reprocessing and diluent selection, (4) planning of demonstration irradiation and utility seminar, (5) economic evaluation, and (6) program review and planning. (auth)

28078 USE OF NUCLEAR ENERGY IN STEELMAKING: PROBLEMS AND PLANS. Com. Naz. Energ. Nucl., Notiz.; 20: No. 12, 53-57(Dec 1974). (In Italian).

A review of the current activities and plans for the eventual utilization of nuclear heat in steelmaking is presented. (auth)

28079 NUCLEAR HEAT IN STEEL INDUSTRY. Savioli, F.; Pasero, E.; Rossi, F. (Centro Sperimentale Metallurgico, Rome). Energ. Nucl. (Milan); 22: No. 3, 149-158(Mar 1975). (In Italian).

From 13th nuclear energy conference on nuclear energy in perspective; Milan, Italy (12 Dec 1974).

Taking into account the peculiar situation of the Italian steel industry in the European frame, some possibilities of using nuclear process heat as an alternative energy source in steelmaking are analyzed. Known technologies, such as blast furnace and oxygen steelmaking, are compared with iron ore direct reduction and electric furnace melting of the produced iron sponge, and a first evaluation is made of the contribution that nuclear heat might give to cover part of the total thermal needs of some of these steelmaking processes. The research activities in the field of direct reduction presently carried on at the CSM (Centro Sperimentale Metallurgico) laboratories are also described, and the possibilities are shown to use their results for the development of a nuclear steelmaking plant concept. 10 references. (auth)

Propulsion and Package Reactors

Refer also to abstracts 25491, 25493, 25494, 25498–25501, 25505, 25508–25565, 25567–25613, 25615, 25616, 25618–25623, 25721, 25723, 25725, 25726, 25735, 25736, 25919–25924, 25929–25932, 26236, 26237, 26239, 26277, 26279–26284, 26303, 26305, 26306, 26318, 26329, 26332, 26334, 26435–26439, 26473–26475, 26500, 26507, 26509, 28660, 28665–28667, 28669–28674, 28680, and 28784–28798.

28080 (AGC-119) FRACTURE MECHANICS METHODOLOGY. Project 187. Schwartz, M. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1972. 53p. Dep. NTIS $5.50.

Often it is not easy to determine whether a material will fail by ductile fracture or brittle fracture. In the case of ductile failure analysis, we need only assure that the primary stress intensity limits do not exceed the yield strength (a property which is easy to establish). For a brittle type of failure, it is necessary to determine the critical stress intensity factor and also some knowledge of the size, shape, orientation and distribution of pre-existent flaws: A great deal of data is required for a valid statistical interpretation, especially where the environment varies appreciably. Therefore, the cost is far greater. Structural failure by deformation may interfere with the function before ductile failure, in which case the yield strength is a proper criterion and a maximum deformation can serve as the failure limit. Brittle failure equations for static and cyclic loading are presented, which leads to a consideration of fatigue. The effects of flaws and non-uniform stresses are discussed. The concept of reliability is introduced and the overlap of stress and strength distributions considered. Since the variance of the net critical fracture stress may be significantly larger than the variance of the yield strength, the reliability based on a brittle analysis may be smaller than that based on a ductile analysis. Computer codes are given and the methods are applied to three NERVA components. (LTN)

28081 (AGC-1164(Add.)) DEVELOPMENT OF A NUCLEAR ROCKET, 5-YEAR PROGRAM. (Aerojet-General Corp., Azusa, Calif. (USA)). 15 Aug 1956. 20p. Dep. NTIS $4.00.

Declassified 13 May 1969.

The proposed 5-year program has a twofold purpose: (1) to produce a complete, full-scale, developmental, nuclear-rocket propulsion system, ready for testing, and (2) to furnish complete design criteria and a preliminary design for a prototype nuclear-rocket propulsion system, together with a complete analysis and the construction of all required test facilities. The program is, however, flexibly designed in order to permit adjusting to various technical, economic, or political factors. In short, this is a preliminary engineering report, proposing to close the gap between theory and practice in the application of nuclear power to the propulsion of high-powered, long-range rockets. (auth)

28082 (AGC-2313) NERVA PROGRAM PLAN FACILITIES SUPPLEMENT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1962. 63p. Dep. NTIS $6.25.

This supplement presents the REON estimate of the NRDS facilities requirements in support of the NERVA test program and a brief description of the pertinent items. (auth)

28083 (AGC-2487(Rev.A)) RELIABILITY AND QUALITY ASSURANCE PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1965. 74p. Dep. NTIS $6.75.

The REON R and QA Program Plan, Report 2487, Revision A, has been prepared to meet the provisions of NPC 200-2 and 200-3 as interpreted by REON and SNPO-C. The Aerojet and major subcontractor plants participating in the NERVA Program shall maintain an effective and timely R and QA Program, planned and developed in conjunction with all other functions necessary to satisfy the SNP-1 contract requirements. The program shall ensure that contract requirements are determined and satisfied throughout all phases of contract performance, including: design, development, fabrication, processing, assembly, inspection, test, checkout, packaging, shipping, storage, maintenance, test preparation, test operation, and test analysis. The program shall provide for the early and prompt detection of actual or potential deficiences, system incompatibility, marginal quality, and trends or conditions which could result in unsatisfactory quality. It shall also provide timely and effective corrective action of all such conditions. The provisions set forth are applicable to the NERVA engine, systems, subsystems, and components, and associated ground support equipment. The reliability and quality programs of each of the Aerojet and major subcontractor plants participating in the NERVA Program are subject to continuous review and evaluation by SNPO-C. The R and QA Program Plan is an integral part of the NERVA engine development plan. The prime purpose of reliability and quality assurance is to support the activities of the NERVA Program in developing the optimum level of inherent reliability and quality, and to assure that systems, subsystems, and subassemblies of the NERVA engine and the support equipment meet the contractual design criteria. (auth)

28084 (AGC-2510(Add.3)) FINAL TEST SPECIFICATIONS FOR TRANSIENT NUCLEAR TEST (KIWI-TNT) OF THE COUNTERMEASURES RADIATION EFFECTS PROGRAM. (Aerojet-General Corp., Azusa, Calif. (USA)). Dec 1964. 77p. Dep. NTIS $7.00.

A KIWI reactor excursion experiment is being conducted at the Nevada Test Site. The Countermeasures Radiation Effects Program has been granted permission to place explosion-proof irradiation capsules containing selected pseudo-stable materials on the reactor pressure vessel and support structure. The anticipated high rate of pulsed neutron and gamma flux will be used to evaluate possible transient effects on explosives and propellants by measuring changes in weight loss, gas release, melting point, vacuum stability, differential thermal analysis, explosion temperature and detonation velocity. Upon completion of the excursion test, irradiated capsules will be recovered and placed into casks, transported to the Vallecitos Atomic Laboratory, removed from the cask and disassembled in the hot cell facility. The pseudo-stable materials will then be transferred to the post-irradiation examination facility for post-irradiation analysis. The specifications describe experimental procedures to be used and evolved from the combined efforts of the participants. (auth)

28085 (AGC-2592(Supp.)) DETAIL DATA FOR COST SUMMARY IN REPORT NO. 2592. (Aerojet-General Corp., Azusa, Calif. (USA)). Jun 1963. 53p. Dep. NTIS $5.75.

28086 (AGC-2603) ENGINE TRANSPORT SYSTEM MAINTENANCE BUILDING DESIGN CRITERIA. (Aerojet-General Corp., Azusa, Calif. (USA)). Aug 1963. 41p. Dep. NTIS $5.25.

The Engine Transport System Maintenance Building will be the central area for servicing and maintaining the railroad rolling stock serving the NERVA Program at the Nuclear Rocket Development Station. The principal equipments requiring an orderly program of preventive maintenance are the Engine Installation Vehicle (EIV), the Prime Mover (locomotive) (PM), and the Manned Control Car (MCC). This facility shall include the required areas, equipment, and services to accomplish the previously stated objectives. Since the operational flow of rolling stock centers mainly around the E-MAD Facility, the Engine Transport System Maintenance Building shall be located at a site convenient to that Facility. The design criteria for this building are listed. (auth)

28087 (AGC-2630) PRELIMINARY DESIGN OF NERVA EXHAUST SYSTEM (SST-2) FOR ETS-1 DUCT. (Aerojet-General Corp., Azusa, Calif. (USA)). Sep 1963. 207p. Dep. NTIS $13.50.

The preliminary design of the NERVA Exhaust System (NES) duct for the ETS-1 at NRDS designated SST-2, subsonic turn configuration, is presented. The performance and internal configuration of the selected subsonic turn ejector system (SST-2 duct) was determined from the subscale testing program. To prevent engine nozzle flow separation, the turbine nozzle must be ducted through supersonic nozzles located at the nozzle exit plane when a 25 : 1 area ratio nozzle is used. The duct will accommodate a 25 : 1 area ratio nozzle, non-gimballed NERVA engine and a 10 : 1 area ratio nozzle with 1° gimbal. The duct shock system will be established and the engine nozzle will flow full from 230 to 250 psia chamber pressure. The preliminary design has been completed to the degree necessary to proceed with the final design. (auth)

28088 (AGC-2630(App.A)) PRELIMINARY DESIGN OF NERVA EXHAUST SYSTEM (SST-2) FOR ETS-1 DUCT. (Aerojet-General Corp., Azusa, Calif. (USA)). Sep 1963. 54p. Dep. NTIS $5.75.

28089 (AGC-2630(Vol.2)) PRELIMINARY DESIGN OF NERVA EXHAUST SYSTEM(SST-2) FOR ETS-1 DUCT. Appendices D and E. (Aerojet-General Corp., Azusa, Calif. (USA)). Dec 1963. 458p. Dep. NTIS $26.00.

Analyses performed on the ETS-1 duct in support of preliminary design concepts are presented. Basically, the report consists of three parts: structural design criteria, structural analysis, and weights. The most critical problem associated with the structural design of the duct was designing a coolant passage that would withstand the thermal and mechanical stresses associated with the heat fluxes and coolant pressure within the duct. The investigation centered about numerous geometric configurations; however, no configuration could resist the associated stresses within the elastic limit of considered materials. Consequently, an elastoplastic analysis was undertaken to establish a limit for the useful life of the system. Thirty operating cycles were established as the expected life required. (auth)

28090 (AGC-2743(Vol.2)) EVALUATION OF THE REQUIRED SEPARATION DISTANCE BETWEEN ENGINE TEST STANDS NO. 1, AND NO. 2. Volume II. (Aetron, Covina, Calif. (USA)). Nov 1963. 158p. Dep. NTIS $11.00.

The effects of possible damage by accidental chemical (H_2) or nuclear explosions at a test stand are calculated for a variety of imagined accidents in order to decide how far apart two test stands should be. The worst explosion visualized was equivalent to approximately 2 tons of TNT and many of the calculations involve estimating the damage to the other test stand from a variety of explosions up to this size. Fallout from a nuclear excursion is considered. The results are given in terms of peak pressure versus distance from the explosion. (LTN)

28091 (AGC-4510-1046) NERVA RELIABILITY TECHNIQUES PROBABILISTIC DESIGN ANALYSES EXAMPLES. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. 342p. Dep. NTIS $20.25.

The methods by which the probability of reliability of the major components of the NERVA system was estimated are given. The methods are quite complex and differ depending on the part involved, its functions and the stresses acting on it. (LTN)

28092 (AGC-7466) FIRST IRRADIATION TEST ON STRUCTURAL MATERIALS. Preliminary Report. McQueen, H. S.; Weleff, W.; Emmons, W. F. (Aerojet-General Corp., Azusa, Calif. (USA)). 16 Oct 1962. 16p. Dep. NTIS $4.00.

28093 (AGC-7850-0683) DISCUSSION OF NPRD RELIABILITY PHILOSOPHY (C. O. 70-15) AND DESIGN PHILOSOPHY FOR ENGINE AND COMPONENT PDR. (Aerojet Nuclear Systems Co., Azusa, Calif. (USA)). 25 Jun 1970. 184p. Dep. NTIS $12.25.

28094 (AGC-7899-1) DESIGN STUDY OF ENGINE CONTROLS AND REACTOR INSTRUMENTATION FOR A NUCLEAR FLIGHT TEST ENGINE. Preliminary Report. Schaffer, D. J. (Bendix Corp., Southfield, Mich. (USA). Research Labs. Div.). 28 Jan 1961. 154p. Dep. NTIS $10.75.

For Aerojet General Corp., Azusa, CA.

A preliminary design analysis of all engine control system components, nuclear instrumentation, and auxiliary power supply equipment for a nuclear flight test engine is presented. (JWR)

28095 (AGC-8209-64-2) OPERATIONAL DESCRIPTION OF THE HOT BLEED PORT PROGRAM, JOB AB 1108. Stiger, R. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 3 Feb 1964. 28p. Dep. NTIS $4.50.

The Hot Bleed Port Program calculates flow rates, temperatures, and pressures throughout the entire Hot Bleed Port system for a steady state point with given cold inlet temperature and pressure, hot inlet temperature and pressure, and a turbine power control valve position. The program requires input data

to describe the physical system. The ability to change the physical characteristics of the system is valuable in determining designs parameters. (auth)

28096 (AGC-9443-63-8) TEST SPECIFICATIONS AND PROCEDURES FOR NERVA THRUST STRUCTURE S/N 001TS RESONANCE SURVEY. Locke, J. N. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Apr 1963. 14p. Dep. NTIS $4.00.

Test specifications and procedures are provided for a resonance survey of a NERVA thrust structure assembly, S/N 001TS, to determine its natural frequencies and mode shapes. The structures are presently being fabricated at LRP and prior to this test shall be subjected to a static limit load survey. The testing will be conducted at room temperature and will provide information on the dynamic characteristics of the thrust structure of use in design. (auth)

28097 (AGC-90016) DESIGN SPECIFICATION: ENGINE, ROCKET, NUCLEAR, XE-1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1965. 45p. (RN-DR-0020). Dep. NTIS $5.25.

This specification covers the design requirements for the Hot-Bleed, Shielded, Nuclear Rocket Engine, XE-1 configuration, which is to be a ground test experimental version of the NERVA engine series. The engine shall be suitable for static firing tests in Engine Test Stand No. 1 at the Nuclear Rocket Development Station in Nevada with the engine oriented in a nozzle-down position. In addition, the engine shall be designed to withstand the structural loads which would be imposed by a firing test in Test Cell "A" with the engine oriented in a nozzle-end up position. This engine features an external radiation shield located forward of the pressure vessel closure. The XE-1 Engine design consists of the following major subsystems: A propellant feed system with turbopump assembly and connecting lines for propellant flow; a reactor assembly consisting of graphite core, beryllium reflector, dummy shield, and reactor control system inner loop; a thrust chamber assembly consisting of the pressure vessel assembly, the nozzle assembly, with bleed port and a thrust structure with an upper thrust structure and a lower thrust structure; the external shield with penetrations for fluid lines and control rod extension shafts, and containing borated water and removable steel balls; an emergency cooldown system as a safety provision for engine tests; a pneumatic system for the engine actuators; a control system to provide the desired engine operations; and a diagnostic instrumentation system. (auth)

28098 (AGC-90016A) DEVELOPMENT DESIGN SPECIFICATION: ENGINE, ROCKET, NUCLEAR, XE-1. (Aerojet-General Corp., Sacramento, Calif. (USA)). 22 Sep 1965. 38p. Dep. NTIS $5.00.

This specification delineates the design requirements for the Hot-Bleed, Shielded, Nuclear Rocket Engine, XE-1 configuration, which is to be a ground test experimental version of the NERVA engine series. The engine shall be suitable for static firing tests in Engine Test Stand No. 1 at the Nuclear Rocket Development Station in Nevada with the engine oriented in a nozzle-down position. The XE-1 Engine design shall consist of the following major subsystems: A propellant feed system with turbopump assembly (TPA) and connecting lines for propellant flow; a reactor assembly consisting of graphite core, beryllium reflector, dummy shield, and reactor control system inner loop; a thrust chamber assembly consisting of a pressure vessel assembly and nozzle assembly; an external shield with penetrations for fluid lines and control drum extension shafts with the shield containing borated water and removable steel balls; an upper and lower thrust structure; a pneumatic system for the engine components actuators; a control system to provide the prescribed engine operations; and a diagnostic instrumentation system. (auth)

28099 (AGC-90017) DESIGN SPECIFICATION: NUCLEAR REACTOR SUBSYSTEM FOR THE XE-1 ENGINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Aug 1965. 19p. Dep. NTIS $4.00.

This specification establishes the design requirements for the Nuclear Reactor Subsystem for the XE-1 Engine. The shielded nuclear reactor subsystem shall consist of a hydrogen-cooled, graphite-moderated, intermediate neutron energy reactor with an aluminum-simulated shield, designed for the XE-1 chamber conditions listed. The reactor shall consist of the following assemblies: The core assembly consisting of clustered graphite—uranium fuel elements supported axially from the dome end by cooled metal tie rods and bundled radially by the graphite inner reflector and its lateral support structure; the outer reflector assembly consisting of twelve beryllium segments, each having a longitudinal hole for control drums—with each control drum containing a boron-aluminum poison element; the shield assembly consisting of an aluminum block simulating a flight-type shield geometry; the screen assembly; and the reactor control subsystem to be used in conjunction with the engine controls and engine programmer to position the control drums during startup, full power, shutdown and restart. Many more detailed specifications are listed. (auth)

28100 (AI-AEC-12894) SNAP REACTOR PROGRAMS PROGRESS REPORT, AUGUST–OCTOBER 1969. (North American Rockwell Corp., Canoga Park, Calif. (USA)). 30 Dec 1969. Contract AT(04-3)-701. 201p. Dep. NTIS $13.35.

Declassified 6 Sep 1973.

Information is presented concerning performance testing of the S8DR, design analysis for reference zirconium hydride reactor, thermoelectric converter development, reactor–thermoelectric system engineering, component development, fuel development, and aerospace safety. (DCC)

28101 (AI-AEC-13002) PROTOTYPE S8DR FUEL ELEMENT PERFORMANCE TEST (NAA 121-1 EXPERIMENT). LeBlanc, J. G. (North American Rockwell Corp., Canoga Park, Calif. (USA)). 15 Jul 1971. Contract AT(04-3)-701. 59p. Dep. NTIS $6.00.

Declassified 10 Mar 1975.

The NAA 121-1 Irradiation Experiment consisted of four S8DR prototype fuel elements with Hastelloy N cladding, SCB-1 hydrogen barrier, and 10% uranium–zirconium hydride fuel. The fuel elements were operated for 12,000 hr in the Hanford KE reactor, at cladding temperatures up to 1300°F and fuel temperatures up to 1450°F, and were discharged with a peak burnup of 0.32 metal at.%. A parallel out-of-pile test was also performed, in which an additional four elements were thermally treated to match the fuel temperature and operating cycles of the in-pile test. The post-test examination of the in-pile elements revealed no cladding damage to the nominal-hydrogen-content (1.73 H/Zr) elements, and nominal fuel growth, consistent with accepted UZrH fuel growth correlations. A low-hydrogen-content (1.59 H/Zr) in-pile element was intentionally subjected to β-δ phase change, and was found to have badly damaged fuel and cladding. All out-of-pile elements were unchanged, except for minor fuel dimension changes due to axial hydrogen redistribution. (7 references) (auth)

28102 (AI-AEC-13003) FINDINGS OF THE SNAP 8 DEVELOPMENTAL REACTOR (S8DR) POST-TEST EXAMINATION. Lillie, A. H.; Rooney, V. L. Jr. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1971. Contract AT(04-3)-701. 93p. Dep. NTIS $7.75.

Declassified 5 Sep 1973.

After 7,000 hours of operation, the SNAP 8 Development Reactor (S8DR), a 600-kwt, 1300°F NaK cooled U-ZrH fueled, compact reactor was shut down and examined at the Atomics International Hot Laboratory to determine the cause of premature fuel element cladding ruptures. The post-test examination observations and findings are presented and discussed. (auth)

28103 (AMA-70-41) COMPARATIVE NERVA/CHEMICAL INTERPLANETARY PERFORMANCE DATA. Mann, F. I.; Horsewood, J. L. (Analytical Mechanics Associates, Inc., Seabrook, Md. (USA)). Nov 1970. 981p. Dep. NTIS $52.25.

For Aerojet Nuclear Systems Co., Sacramento, CA.

Comparative NERVA/chemical performance data are presented, assuming 1980-1990 projected state-of-the-art technology, for missions to all of the planets. Data are presented for orbiter missions to Mercury, flyby missions to Jupiter, Saturn, Uranus, Neptune, and Pluto, and manned stopover missions to Venus (orbiter) and Mars (orbiter and lander) with return to a low circular orbit about Earth. The Mars mission employs a swingby of Venus on the outbound leg. Initial vehicle gross weight is minimized for all missions, which are assumed to begin in a low circular parking orbit consistent with Cape Kennedy launch requirements. Gross weight sensitivities to variations of NERVA thrust, specific impulse, engine weight, and propellant mass fraction are provided. Also considered are chemical-propulsion orbit establishment requirements for the outer planet missions, the utility of a Jupiter swingby for out-of-the-ecliptic and solar probes, and Mercury deorbit and soft-landing requirements. The well-established performance advantage of nuclear propulsion over chemical propulsion is confirmed, although the existence of a cost advantage remains to be conclusively proved. The data presented are appropriate as inputs to cost analysis studies. (auth)

28104 (ANSC-CID11-A035) COMPARATIVE NERVA/CHEMICAL INTERPLANETARY PERFORMANCE DATA. Foschetti, J. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 421p. Dep. NTIS $24.25.

Comparative NERVA/chemical performance data are presented assuming 1980-1990 projected state-of-the-art technology for missions to all of the planets. Data are presented for orbiter

missions to Mercury, flyby missions to Jupiter, Saturn, Uranus, Neptune, and Pluto, and manned stopover missions to Venus (orbiter) and Mars (orbiter and lander) with return to a low circular orbit about Earth. Also included are the 4-planet (Jupiter, Saturn, Uranus, Neptune) and the 3-planet (Jupiter, Saturn, Pluto) Grand Tour Missions and an unmanned Mars High Orbiter and Soft Lander Mission. The manned Mars mission employs a swingby of Venus on the outbound leg. Initial vehicle gross weight is minimized for the manned Mars and Venus missions and the unmanned Mercury mission, while the remaining missions assumed an initial gross weight and maximized the payload. All missions are assumed to begin in a low circular parking orbit consistent with Cape Kennedy launch requirements. Gross weight sensitivities to variations of NERVA thrust, specific impulse, engine weight, and propellant mass fraction are provided. Also considered are chemical-propulsion orbit establishment requirements for the outer planet missions and the Grand Tour Missions, the utility of a Jupiter swingby for out-of-the-ecliptic and solar probes, and Mercury and Unmanned Mars deorbit and soft-landing requirements. Nuclear propulsion is the only serious candidate for any long distance, manned missions that may be planned in the future. Chemical propulsion systems can place only minimal probe weights towards the outer planets and require long transfer times. Only a minimal number of small surface probes can be placed on the near planets. (auth)

28105 (BMI-X-10131) STUDIES OF IRRADIATION EFFECTS ON SYSTEMS. Six-Month Summary Report. Drennan, J. E. (Battelle Columbus Labs., Ohio (USA)). 1 Jul 1965. 5p. Dep. NTIS $4.00.

The development of a model experimental design for NERVA-instrumentation radiation-effects tests is reported briefly. Radiation-test-facility needs for future nuclear-engine developments are also considered. (DLC)

28106 (COM-74-10539/6) BIBLIOGRAPHY OF MARINE NUCLEAR STANDARDS. McMichael, D. B. (National Maritime Research Center, Galveston, Tex. (USA)). Feb 1974. Contract MA-6562. 37p. (NMRC-273-34200-RI; MA-RD-900-74042). NTIS $3.25.

A bibliography is presented which is representative of reading reference material used in the development of a workable handbook showing cross-references to existing international data and identifying areas where international committees need to be created to agree on a standardized program for nuclear ship construction and operation. The bibliography is divided into three codes: code 1 is representative of documents deemed current, relevant, and marine-related; code 2 is representative of documents deemed relevant and marine-related; and code 3 is representative of documents deemed to be relevant, whether or not current or marine-related. (GRA)

28107 (EGG-1183-1396) ETS-1/A AND E DATA LINK MANUAL. Erickson, K. (EG and G, Inc., Las Vegas, Nev. (USA)). 1 Aug 1968. 47p. Dep. NTIS $5.50.

This manual describes the data link system used at Nuclear Rocket Development Station, Jackass Flats, Nevada. Information is presented on the operational aspects. System descriptions, checkout procedures, and preventative maintenance information are included. (DLC)

28108 (GA-8985) DEVELOPMENT OF A THERMIONIC REACTOR SPACE POWER SYSTEM. Summary Report for Period November 1, 1968–February 28, 1969. (Gulf General Atomic Co., San Diego, Calif. (USA)). 7 Mar 1969. Contract AT(04-3)-167. 134p. Dep. NTIS $9.75.

Declassified 4 Mar 1975.

Information on thermionic space power reactors is presented concerning reactor materials development, converter technology, converter testing, reactor technology, and system design and analysis. 12 references. (DCC)

28109 (GA-9551) DEVELOPMENT OF A THERMIONIC REACTOR SPACE POWER SYSTEM. Summary Report, November 1, 1969–February 28, 1970. (Gulf General Atomic Co., San Diego, Calif. (USA)). 26 Mar 1970. Contract AT(04-3)-167. 195p. Dep. NTIS $12.75.

Information is presented concerning the fabrication parameters and testing of reactor materials, design and fabrication of thermionic converters, testing of thermionic converters, reactor kinetics, and design considerations for the Thermionic Reactor Experiment (TREX) (DCC)

28110 (GA-9594) DEVELOPMENT OF A THERMIONIC REACTOR SPACE POWER SYSTEM. Summary Report for Period March 1, 1970–June 30, 1970. (Gulf General Atomic Co., San Diego, Calif. (USA)). 13 Aug 1970. Contract AT(04-3)-167. 204p. Dep. NTIS $13.25.

Declassified 4 Mar 1975.

Progress is reported in the areas of: (1) materials technology, (2) converter technology, (3) converter testing, (4) reactor technology, (5) reactor experiment conceptual design, and (6) system technology. (DG)

28111 (GESR-2119) DEVELOPMENT OF A SPACE THERMIONIC REACTOR POWER PLANT. Third Periodic Progress Report, March 1–June 30, 1969. (General Electric Co., Pleasanton, Calif. (USA). Nuclear Thermionic Power Operation). 1969. Contract AT(04-3)-771. 314p. Dep. NTIS $18.75.

Declassified 4 Mar 1975.

Information on thermionic space power reactors is presented concerning materials technology, converter technology and irradiation testing, thermionic reactor technology, and systems technology. 37 references. (DCC)

28112 (JAERI-M-12) WORKS OF FUEL LOADING AND THE RESTORATION OF REACTOR IN N. S. MUTSU. (Japan Nuclear Ship Development Agency, Tokyo). Sep 1974. 113p. (In Japanese). Dep. NTIS (US Sales Only).

Fuel loading and subsequent restoration of reactor in n. s. Mutsu, Japan's first nuclear-powered ship, were started on September 3 and completed on October 3, 1972, by closing reactor room with a hatch cover. The procedures of works from preparation to completion are described for reference in similar works in the 2nd nuclear powered ship to be built in the future. (auth)

28113 (LA-4716) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING MAY 31, 1971. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1971. Contract W-7405-eng-36. 45p. Dep. NTIS $5.25.

Declassified 3 Mar 1975.

28114 (NJD-2) NRX/EST TEST SPECIFICATION. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1965. 155p. Dep. NTIS $10.75.

28115 (NJD-3) NRX/EST OPERATIONAL SUPPORT PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1965. 150p. Dep. NTIS $10.50.

This operational support plant presents in chronological sequence the functional operations that must be performed to complete each step of an individual NRX/EST test and categorically lists the equipment required to accomplish each operation. Included are the operations and support equipment required in the packaging and shipment of the non-nuclear components from Aerojet-General (AGC-REON), Sacramento, California, the Packaging and shipment of the reactor/vessel from Westinghouse Astronuclear Laboratory (WANL) Large, Pennsylvania, the receiving of components, integration of components, preparation for testing, hot disassembly, post/operative examination at the Nuclear Rocket Development Station (NRDS) at Jackass Flats, Nevada, the disposition of components, and the post-operative examinations at other facilities. (auth)

28116 (NJD-4) JOINT REPORT ON THE NRX/EST PROVISIONING LIST AND SCHEDULE TO THE SPACE NUCLEAR PROPULSION OFFICE, CLEVELAND, OHIO. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Jan 1966. 247p. Dep. NTIS $15.50.

28117 (NJD-10(Add. 1-2) (Rev. 1)) XE-1 SAFETY EVALUATION REPORT, PHASE I-A. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Oct 1967. 22p. Dep. NTIS $4.25.

The safeguards by which accidental criticality will be prevented during XE-1 assembly operations, check out and poison wire removal are summarized. The operations were complicated by the necessity of cleaning some debris from the core area. Operations with respect to (1) the control drums (which required removal and cleaning) and (2) the poison wire removal were quite complex and detailed. (LTN)

28118 (NJD-10(Rev. 1)(Supp. 1)) XE-1 SAFETY EVALUATION REPORT, PHASE 1B. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1968. 42p. Dep. NTIS $5.25.

Safeguards are established to prevent accidental criticality during assembly, transport, and checkout operations from initiation of central poison wire removal up to, but not including, initial criticality at the Engine Test Stand (ETS-1). The potential mechanisms which could lead to an accidental criticality of the XE-1 reactor prior to initial criticality are accidental insertions of moderation (particularly hydrogenous material) after

removal of the shipping poison wires, loss of shutdown margin through excess reflection, accidental rotation of control drums during periods when auxiliary poison is not used, and loss of shutdown margin during removal of the auxiliary poison. The safeguards against these potential problems are outlined. (auth)

28119 (NJD-11) XE-1 SAFETY EVALUATION REPORT, PHASE II. Supplement I. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb. 1969. 87p. Dep. NTIS $7.50.

A brief summary of the planned tests is provided with emphasis on the safety aspects. The inputs and automatic actions of the emergency/scram shutdown chain are given and the override and inhibit setpoints are listed. The inputs and setpoints specified have been developed through past experience with NRX reactor operations; through current evaluations of the XE control system, test assembly and ETS-1 facility; and from the results of the XE malfunction studies discussed above. The shutdown, override and inhibit circuits to be active during each phase of engine testing are also given. The protective circuits which will be active for a specific Experimental Plan will be checked out under Status Board control prior to the conduct of the EP, or during the early phases of the EP. Test Parameter Limits have been established to minimize the risk of damage to the test assembly during the performance of the test program. These limits along with their individual justification are contained in the XE Test Specification. On the basis of the XE-Prime malfunction analyses, the present inputs and settings to the XE Safety System do not protect the engine for the complete range (less than 5°/sec) of slow drum rollouts from high T_c operating conditions. Since slow drum rollouts can occur as the result of single malfunctions within the engine control system, an investigation into means for improving the protection of the engine in the event of this type of malfunction is continuing. (auth)

28120 (NJD-12) XE-1 OPERATING LIMITS DOCUMENT PHASE I-A. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1967. 9p. Dep. NTIS $4.00.

28121 (NJD-12(Rev. 1)) XE-1 OPERATING LIMITS DOCUMENT, PHASE IA. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1967. 11p. Dep. NTIS $4.00.

Revision 1 changes the scope of Phase IA of the assembly operations to include all operations up to, but not including, central poison wire removal. The specific difference is the inclusion of installation of the control drum actuators. (auth)

28122 (NJD-12(Rev. 2)) XE-1 OPERATING LIMITS DOCUMENT PHASE I. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1968. 17p. Dep. NTIS $4.00.

28123 (NJD-21) NERVA JOINT DOCUMENT. Shield Study Report. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 284p. Dep. NTIS $17.25.

The objectives, methods, models, assumptions, interim judgments, and conclusions of the Aerojet-Westinghouse Joint Shielding Study conducted from June through September 1968 are documented. The study was directed toward: (1) determining the minimum shielding weight needed for specific manned missions; (2) determining a NERVA engine/reactor design concept that could accommodate a range of shield weights as required for the various missions; (3) accomplishing the foregoing without an undue weight penalty for any given mission or undue complexity in the engine/reactor design. The manned-mission shielding studies were parametric studies leading to the optimum configuration for minimum shield weight. The general conclusions may be summarized: 1. When substantial payloads are involved in manned applications, they could serve an important shielding function. Therefore, in any future spacecraft or payload design using a nuclear stage, consideration should be given to arranging spacecraft components to provide additional crew protection. 2. Provisions to reduce radiation from sources outside the active nuclear core, (e.g., the propellant lines and the nozzle) by local shielding are desirable. 3. Increasing the separation distance between the reactor and tank or between the crew capsule and the tank can be as effective as the installation of shields. 4. For the configurations studied, disk shields located 81-in. above the core center will not require cooling, provided that 3,300 lb of shielding are included in the nuclear subsystem. (auth)

28124 (NR-69053(Folder 1)) PROTOTYPE PRIMARY NaK LOOP VALVE SETS. Folder 1. Technical Proposal. (Aerojet-General Corp., Sacramento, Calif. (USA)). 24 Jun 1969. 150p. Dep. NTIS $10.50.

The overall objective of the program is to supply three prototype primary Nak loop (PNL) valve sets for use in ground testing of the SNAP-8 power-conversion system. Accomplishment of this object will require design, fabrication, and testing of the valves. The Technical Discussion states the detailed program objectives, summarizes the various requirements that influence the valve design, discusses the anticipated problem areas, and describes the envisioned approaches to solutions. The Technical Discussion also describes two feasible valve concepts and outlines the various disciplines of engineering analysis required, as well as the quality-assurance requirements. (auth)

28125 (NRX-AL-R-5) NRX-A1 THIRTY-SIX DAY TEST REPORT. Dorsey, C. M.; Hosler, D. P.; Purvis, J. E.; Sadler, J. W.; Scott, D. L.; Turner, R. D. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 22 May 1964. 183p. Dep. NTIS $12.25.

The NRX-A1 Test Series was performed at NRDS during March and April of 1964. It consisted of many cold flow-startup profiles (both ambient and cryogenic) through the NRX-A1 Test Article. The unfueled NRX-A1 Test Article and the series of tests performed resulted from a re-alignment of the NERVA program (as a result of the KIWI tests of 1962 and 1963) to require cold flow testing of a reactor design prior to nuclear operation to investigate flow-induced vibration. The major objectives of the NRX-A1 Tests were: To determine the effects of the planned test conditions on the dynamic stability and the structural integrity of the test assembly and its components; and to demonstrate the ability of the various components and sub-assemblies to perform their function adequately under the planned test conditions. The NRX-A1 Test Series was considered successful in that useful data were obtained and no apparent damage to the Test Article under the conditions of the testing was observed. All profiles were successfully performed as planned or as approved by the Test Review Board and all test objectives were apparently satisfied. (auth)

28126 (NTO-2656) ORGANIZATION OF NERVA TEST OPERATIONS. Nuclear Rocket Development Station. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 5 Aug 1963. 69p. Dep. NTIS $6.50.

A detailed outline is presented of the organization for testing of the NERVA engine, the NRX reactors, and other equipment associated with the NERVA program. (JWR)

28127 (NTO-25457) TRANSMITTAL OF SEMI-MONTHLY PROGRESS REPORT. For the Period 1 August–15 August 1968. Wayne, W. D. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 12 Sep 1968. 29p. Dep. NTIS $4.50.

Reactor test operations, ETS-1 operation, health and safety, MAD operations, documentation and reporting, and technical support are reported. (DLC)

28128 (NTO-M-25475) TRANSMITTAL OF NTO CONTRIBUTION TO THE NERVA ANNUAL SUMMARY REPORT, CONTRACT YEAR 1968, WANL-PR(J)-051. Wayne, W. D. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 19 Sep 1968. 56p. Dep. NTIS $6.00.

Ground operations safety, quality control, general support, Test Cell "C" operations, ETS-1 operations, and MAD operations are covered. (DLC)

28129 (NTO-R-0072) NRX-EST SITE TEST REPORT. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 132p. Dep. NTIS $9.75.

The NRX/EST Test Series was successfully conducted at the Test Cell "A" facilities of the Nuclear Rocket Development Station, Jackass Flats, Nevada, between December 8, 1965 and March 25, 1966, inclusive. The NRX/EST Test Series was conducted using an engine-type configuration Test Assembly. The most significant operations and accomplishments with regard to the Test Series are discussed. In general, performance of the reactor and engine system were in accordance with pre-test predictions. Reactor parameters, such as temperatures, temperature distribution, pressures, pressure drops, and engine system performance were reproducible from one test to another. Fuel element corrosion with the significant core reactivity loss (as shown by the high drum position) during the last Experimental Plan was more than predicted. (auth)

28130 (NTO-R-0143) THREE-DAY REPORT FOR EXPERIMENTAL PLAN II. XECF Test Series. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 11 Apr 1968. 40p. Dep. NTIS $5.00.

Qualitative results of XECF-EP-II are presented. The two bootstrap startups indicate that the engine, from the nozzle torus to the chamber, performance is not related to the initial pump chill. These two pump speed vs time traces are essentially the same with the only time differences preceding TPCV opening. The

LH_2 insertion tests will be investigated more fully. The steam generators performed very satisfactorily and operated at full steam from an initial 1160°R to 1300°R for approximately 47 minutes. Although the ETC emergency purge system received sporadic trip signals prior to achieving stable steam generator conditions, after activation it did not trip during the 47 minutes of operation. No anomolies or conditions were observed which would preclude further testing. (auth)

28131 (NTO-R-0154) FDET REPORT, FEP-V LN_2 CRYOSHOCK. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 27 Jul 1968. 120p. Dep. NTIS $9.00.

An LN_2 Cryoshock was performed on the modified ETS-1 LH_2 high pressure cooldown system and temporary engine simulator piping. This is routinely done as part of the pressure testing of new or extensively modified piping. Joints which are leak-tight at ambient temperatures but shrink up and leak at cryogenic conditions are detected with LN_2 and corrected, more economically and in a safe manner, prior to subjecting the system to LH_2. Flow tests were conducted in conjunction with the LN_2 cryoshock so that major problems in controllers, instrumentation, chilldown techniques, operational methods, check valve and other component performances, etc., would be discovered and corrected prior to FEP-V. In addition, some basic facility performance data has been obtained. (auth)

28132 (NTO-R-0170) SPEAR REPORT: XE-PRIME EP-V. Data from Aborted Power Test. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1969. 185p. Dep. NTIS $12.25.

An attempt to perform a full power test, XE-PRIME EP-V, was aborted after two attempts on May 15 and 16, 1969. Although it was established that the turbopump failed to rotate when startup conditions were such that it should start, the reason for non rotation was not established. Although the purge requirements had been met and were similar to those used in previous successful runs, the suspicion of trouble in this procedure remained. Certain other anomalous instrument readings suggested a hydrogen leak, which should be fixed for other reasons, but probably was not related to the trouble. (LTN)

28133 (ORNL-3420) SPACE POWER PROGRAM SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1962. (Oak Ridge National Lab., Tenn. (USA)). 13 May 1963. Contract W-7405-eng-26. 303p. Dep. NTIS $18.25.

Declassified 31 Aug 1973.

Research and development is carried out on the stainless steel boiling-potassium reactor and the Medium Power Reactor Experiment, boiling alkali metal heat transfer, high-temperature and refractory alloys, and space reactor shielding, particularly in connection with SNAP 2, 8, 10, and 50. Many of these ORNL efforts are centered about the development of a specific type of power plant, but they also furnish a significant contribution of scientific and engineering information needed in other programs on advanced SNAP systems. (auth)

28134 (P-TR-0001) PHOEBUS-2 NOZZLE TENTATIVE FINAL QUALITY PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1965. 67p. Dep. NTIS $6.50.

28135 (P-TR-0002) PHOEBUS-2 NOZZLE INTERMEDIATE RELIABILITY PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1965. 29p. Dep. NTIS $4.50.

28136 (RAPO-001(Rev.C)) TRIAL FITTING. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 14 Nov 1967. 12p. Dep. NTIS $4.00.

28137 (RAPO-1012(Rev.L)) SUPPORT RING ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa..(USA). Astronuclear Lab.). 14 Nov 1967. 6p. Dep. NTIS $4.00.

28138 (RAPO-1046(Rev.G)) ORIFICE JET ASSEMBLY REPAIR PROCEDURE. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 14 Nov 1967. 6p. Dep. NTIS $4.00.

28139 (RAPO-1090(Rev.G)) SUPPORT PLATE ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa (USA). Astronuclear Lab.). 4 Nov 1967. 11p. Dep. NTIS $4.00.

28140 (RAPO-1125(Rev.U)) TIE ROD-STRAIN GAGE ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 14 Nov 1967. 15p. Dep. NTIS $4.00.

28141 (RAPO-1127(Rev.D)) FILLER STRIP ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 9 Jan 1968. 5p. Dep. NTIS $4.00.

28142 (RAPO-1128(Rev.E)) FILLER STRIP THERMAL CAPSULE ASSEMBLY. Baker, W. H.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 5 Jan 1968. 7p. Dep. NTIS $4.00.

28143 (RAPO-1131(Rev. G)) ELEMENT THERMAL CAPSULE ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 17 Nov 1967. 8p. Dep. NTIS $4.00.

28144 (RAPO-1132(Rev. F)) THERMOCOUPLE ELEMENT PLUG INSTALLATION. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 17 Nov 1967. 6p. Dep. NTIS $4.00.

28145 (RAPO-1133(Rev.D)) HOLLOW TIE ROD-EXIT GAS THERMOCOUPLE. Baker, W. H.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 22 Jan 1968. 8p. Dep. NTIS $4.00.

28146 (RAPO-1134(Rev. C)) GRAFOIL SLEEVE INSTALLATION. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 14 Nov 1967. 8p. Dep. NTIS $4.00.

Installation and inspection procedures for this operation are defined. Applicable documents and tooling required are specified. (LTN)

28147 (RAPO-1135(Rev. B)) PRESSURE PROBE PREBENDING FOR THE GRAPHITE CYLINDER. Baker, W. H.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 4 Jan 1968. 6p. Dep. NTIS $4.00.

The operations necessary for carrying out and inspecting this operation are defined. Applicable documents and special tools required are listed. (LTN)

28148 (RAPO-2009(Rev. B)) OUTER REFLECTOR, DISASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 26 Apr 1968. 6p. Dep. NTIS $4.00.

28149 (RAPO-2011(Rev. G)) NOZZLE END SUPPORT ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 30 Nov 1967. 5p. Dep. NTIS $4.00.

28150 (RAPO-2012(Rev. G)) DOME END SUPPORT ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 30 Nov 1967. 6p. Dep. NTIS $4.00.

28151 (RAPO-2028(Rev.W)) OUTER REFLECTOR ASSEMBLY, INSTRUMENTED. Baker, W. H.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 28 Nov 1967. 26p. Dep. NTIS $4.50.

28152 (RAPO-2030(Rev.B)) CONTROL DRUM CLEARANCE MEASUREMENT. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 5 Jan 1968. 8p. Dep. NTIS $4.00.

28153 (RAPO-2031(Rev.B)) PRESSURE PROBE ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 17 Nov 1967. 6p. Dep. NTIS $4.00.

28154 (RAPO-3003(Rev.E)) INSTRUMENTATION RING ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 14 Nov 1967. 7p. Dep. NTIS $4.00.

The procedure for assembly of the instrumentation ring defines the assembly and inspection operations required, and lists other applicable documents. (LTN)

28155 (RAPO-3007(Rev.J)) INNER REFLECTOR ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 16 Jan 1968. 12p. Dep. NTIS $4.00.

28156 (RAPO-3030(Rev.E)) FORWARD AND AFT SPRING BEARING RING ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 5 Jan 1968. 6p. Dep. NTIS $4.00.

28157 (RAPO-5003(Rev. K)) OUTER REFLECTOR AND CORE SEAL BLOCK BRAZING. Baker, W. H.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 23 Jan 1968. 20p. Dep. NTIS $4.00.

28158 (RAPO-5007(Rev. S)) ASSEMBLY OF REACTOR/VESSEL. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 23 Feb 1968. 33p. Dep. NTIS $4.75.

28159 (RAPO-5008(Rev. C)) REMOVAL OF THE NOZZLE LEAK TEST CLOSURE. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 22 Jan 1968. 7p. Dep. NTIS $4.00.

28160 (RAPO-6001(Rev. G)) OUTER REFLECTOR AND SHIELD INTERFACE GAGE PROCEDURE. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 22 Jan 1968. 9p. Dep. NTIS $4.00.

28161 (RAPO-6002(Rev.Q)) REACTOR INSTRUMENTATION. Brier, J. C.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). [nd]. 16p. Dep. NTIS $4.00.

28162 (RAPO-8001(Rev. M)) RECEIPT AND PREPARATION OF THE PRESSURE VESSEL. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 5 Jan 1968. 7p. Dep. NTIS $4.00.

28163 (RAPO-8002(Rev. K)) PREPARATION OF THE PRESSURE VESSEL FORWARD CLOSURE. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 5 Jan 1968. 8p. Dep. NTIS $4.00.

28164 (RAPO-8013(Rev. B)) PEDESTAL CONNECTOR HOUSING ASSEMBLY. Anderson, C. W.; Holbrook, A. F. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 20 Nov 1967. 10p. Dep. NTIS $4.00.

28165 (RN-67007) PROGRAM PLAN: MIDYEAR ADJUSTMENT FOR CY 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Feb 1967. 70p. Dep. NTIS $6.50.

Midyear changes in program direction and cost are detailed. The changes were in response to priority changes, specific critical path problems, ETS-1 activation problems, the connector corrosion problem, thrust ring problem, safety modifications, etc. They represent new effort or management responses to delays or problems in on-going programs. (LTN)

28166 (RN-68005) FLUIDIC CHAMBER-PRESSURE CONTROL SUBSYSTEM FOR THE NERVA ENGINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 5 Apr 1968. 58p. Dep. NTIS $6.00.

28167 (RN-69001(Vol. 1)) STATEMENT OF WORK TO BE PERFORMED FROM 1 OCTOBER 1968–30 SEPTEMBER 1969. Supplement XXVI to Appendix B. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1968. 98p. Dep. NTIS $8.00.

Research to be performed on NERVA development and XE design and testing is specified. (JWR)

28168 (RN-69005) AGC PROGRAM PLAN RN-69005, FLUIDIC CONTROLS, SRT. Ryland, G. L. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 3 Mar 1969. 10p. Dep. NTIS $4.00.

28169 (RN-69006) NASS SUBSCALE STEAM EJECTOR PARAMETRIC STUDY. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 May 1969. 12p. Dep. NTIS $4.00.

A plan for subscale (1 : 16) model testing of steam ejectors is proposed. This information is needed for the geometrical optimization of the NASS steam ejector system to be installed at ETS-1. (LTN)

28170 (RN-70013(Enc.1)) STUDY FOR NERVA TELEOPERATOR PROGRAM. Technical Discussion. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 15 Jul 1970. 33p. Dep. NTIS $4.75.

This proposal for a technical study related to the definition and development of NERVA teleoperator systems is submitted in response to the Space Nuclear Propulsion Office Proposal. To achieve the proposed study objective, a detailed systems engineering analysis, incorporating all SNPO requirements and guidelines, will be conducted. This study will evaluate state-of-the-art teleoperator systems as related to the NERVA application as well as other NASA space programs. Performance tasks such as maintenance, servicing and assembly operations for NERVA and the other candidate space systems will be considered. These tasks will then be translated into specific operational requirements and constraints in the form of NERVA teleoperator design criteria, test planning, environmental factors, reliability, safety limits, human performance, transportability and maintainability. (auth)

28171 (RN-70060(Folder 1)) FOLDER 1: TECHNICAL DEVELOPMENT OF AN IMPROVED NEUTRON-ACTIVATION PREDICTION CODE SYSTEM. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 22 Apr 1970. 55p. Dep. NTIS $5.75.

In response to a request, a program is proposed to develop an integrated system of computer codes to compute photon dose rates generated in complicated engineering structures as a result of neutron-induced activation. The integrated system is intended to expeditiously treat neutron transport, neutron-induced activation, and subsequent photon transport to desired detector locations. Versatility of the integrated system will make it readily useable for Point-Kernel-type analysis or more sophisticated Monte Carlo analyses, depending on the problem to be solved. The principal feature of proposed program is to employ computer code bridging/coupling techniques to effect an integrated code system. This will allow the user to choose sophisticated Monte Carlo techniques or less sophisticated Point Kernel techniques, while at the same time employing the Discrete Ordinate (S_n) method for radiation transport analyses where it is best suited (e.g., in neutron slowing down calculations). These techniques have been developed specifically for the prediction of the NERVA engine radiation environment. The neutron and photon transport techniques developed for NERVA operating conditions are generally equally applicable to the shutdown activation problem as well, e.g., in rendezvous or docking operations. The proposed neutron-activation-code development program is simply a logical extension of existing code packages to treat the sources of neutron-induced activation. Much of the development work on bridging codes has been completed under funding from NASA. (auth)

28172 (RN-70063(Pt.1)) STUDY FOR A TELEOPERATOR FLIGHT EXPERIMENT. Part I. Technical Proposal. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 66p. Dep. NTIS $6.50.

This proposal for a technical study related to the development of teleoperator technologies for space use and definition of space flight experiments involving teleoperator system applications is submitted in response to the NASA Manned Spacecraft Center's Proposal Request. The proposed effort will result in documented criteria that identify: the technology required to develop manned space flight teleoperator applications; the teleoperator characteristics that require experimental investigation; and the proposed fundamental experiments that will serve the most useful purpose in extending teleoperator technology. Teleoperator applications for space operations will be identified and teleoperator system requirements established by implementation of system functional analysis techniques. Teleoperator system and subsystem criteria to meet system requirements will be developed. The development of these criteria will consider man-machine trade-offs, implementation of teleoperator systems in lieu of extravehicular activity (EVA), and the impact of the space environment. Teleoperator system and subsystem concepts to meet the established criteria will be formulated. (auth)

28173 (RN-A-0008) SUMMARY REPORT CY '66 FOR PERIOD ENDING 30 SEPTEMBER 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1966. 633p. Dep. NTIS $34.75.

Two major test series were performed at Test Cell A: (1) the NRX/EST series, which involved a test assembly simulating the engine configuration, and (2) the NRX-A5 test series. The most significant accomplishments in the NRX/EST test series, which began in December 1965, were operation of a nuclear-rocket-engine system for the first time with the engine components connected in the flight functional relationship; demonstration of system stability under a number of different control modes while operating the engine over a broad area of its performance map; demonstration of the multiple-restart capabilities of the engine; and demonstration of the endurance capability of the reactor and other engine components by operating at nominal rated conditions for approximately 30 min and at or above a 1700°R chamber temperature for approximately 100 min. Performance of the NRX/EST engine system was generally in accordance with pretest predictions. The most significant accomplishments in the NRX-A5 test series, completed in June 1966, were operation of the test assembly for 30.4 min at close to rated conditions and for 35.3 min at chamber temperatures above 1900°R; operational demonstration of a new eight-decade neutronic system; checkout and operation of the reactor at rated conditions by using a temperature-control system without the neutronics power control as an inner loop; demonstration of the acceptability of a startup from low power to near-rated conditions by using hydrogen reactivity with the drums in a fixed position; and performance of reactor initial-criticality tests after all poison wires had been removed. Performance of the NRX-A5 was generally in accordance with pretest predictions. Many other results of the overall program are presented. (auth)

28174 (RN-A-0011) SUMMARY REPORT CY '68 FOR PERIOD ENDING 30 SEPTEMBER 1968. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1968. 481p. Dep. NTIS $27.25.

Full-power testing of NRX-A6 was successfully performed on 15 December 1967. XECF was successfully cold-flow tested on ETS-1 on 11 April 1968 and subsequently disassembled with its shield set aside for the XE-Prime engine assembly, and its UTSM assembled to the XE-Backup engine for a vibration test. The FEP-V test, to demonstrate all of the cooldown systems, was successfully completed in September 1968, with sufficient data obtained to make final resolution of the cooldown system modifications and to confirm the analog model used in designing the XE system. XE-Prime and XE-Backup engine configurations were established. Both are combinations of the former XE-1 and XE-2. The Xe-Prime engine is being readied for installation into ETS-1 early in the next quarter. Extensive design work involved an analysis of proposed mission requirements and the design of 200K, 106K and 75K thrust reactors as requirements were revised. Equipment development and testing progressed satisfactorily and the significant results for many items are detailed. (auth)

28175 (RN-A-0012) SUMMARY REPORT CY 1969 FOR PERIOD ENDING 30 SEPTEMBER 1969. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Nov 1969. 414p. Dep. NTIS $23.75.

Work continued in three broad areas: (1) the technology program; (2) the NERVA flight-engine program; and (3) various support activities. The major highlight was the successful completion of the XE-Prime engine test series. During the year, the engine assembly was completed, installed in the test stand, and initial tests conducted. XE-Prime low-power mapping and drum- and power-calibration tests were conducted during the second quarter. Startup tests were performed during the third quarter and full power was attained 11 June. The XE-Prime series was concluded 11 September after testing off-normal conditions, various starting modes, and low-flow conditions. The test program included 27 startups, 200 sec at full power, and 1000 sec at chamber temperatures greater than 4000°R. The engine was started and restarted six times during each of two experimental plans. The XE-Prime engine was removed from Engine Test Stand-1 (ETS-1) 25 September and transported to the Engine Maintenance, Assembly, and Disassembly Building (E-MAD) for disassembly, inspection, and storage. The NERVA Mission Data Book and the NERVA Reference Data Book were completed and distributed. The missions described are A, B, C, and Emergency. The engine described is the June reference engine. The NASS duct design (with supporting documentation and the accompanying SGDS requirements specification) was completed to reflect the requirements of the hot-bleed engine. Many other research, development, testing and design results are listed. (auth)

28176 (RN-DR-0001) STRUCTURAL AND DYNAMIC ANALYSIS OF THE NRX-A LH_2 PROPELLANT FEEDLINE. Clark, R. D. (Aerojet-General Corp., Azusa, Calif. (USA)). Oct 1963. 44p. Dep. NTIS $5.25.

A structural and dynamic analysis of LH_2 inlet pipe designs for the NERVA engine test stand was conducted. Loads and deformations due to static (pressure-thermal) and dynamic effects on the pipe and nozzle were established and natural frequencies calculated. It was necessary to place bellows at optimum locations to minimize loads imposed on the piping by thermal effects and other load conditions. Without bellows the flexual stresses were likely to cause failure in the straight pipe sections. (LTN)

28177 (RN-DR-0010) NOZZLE-MOUNTED CAMERA SYSTEM. (Aerojet-General Corp., Azusa, Calif. (USA)). Jun 1964. 60p. Dep. NTIS $6.00.

The environmental conditions, performance requirements, and operational requirements for visual examination of the reactor core during NRX-A1 Cold Flow Tests are described. The discussion includes the methods selected, tests performed, equipment purchased, and the problems of nozzle and camera housing design to obtain the coverage required. (auth)

28178 (RN-DR-0025) PRESSURE VESSEL BOLTED JOINT/THREADED INSERT EVALUATION. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1964. 47p. Dep. NTIS $5.50.

The torque-strain relationship of Type-B threaded inserts is superior to that of Type-A threaded inserts by approximately 20 percent; therefore, for a given bolt preload requirement, 20 percent less torque is required when using a Type-B insert than when using a Type-A insert. This difference may be of considerable significance when remote handling equipment limitations are defined. When nuclear heating is a prime consideration, the lower steel volume of the Type-A insert would tend to make it more suitable. When space limitations are severe, the smaller maximum diameter of the wire coil type insert (Type-A) represents an advantage. The particular materials used in the Nerva NRX-A pressure vessel assemblies require more than 1.5-D thread engagement of plain thread or Type-A inserts to develop full strength capabilities. All 2-D engagement threaded connections proved to be adequate in tensile load capacity. Contamination to the reactor from excessive bolt thread lubricant plugging of the flow passages is a potential hazard. Match-identification of each bolt and mating insert location on the pressure vessel joints is recommended to obtain more consistent bolt preload and to prevent a damaged bolt from injuring more than one insert when recurrent assembly is to be performed. Under carefully controlled assembly conditions, the high strength steel bolts and 2-D type-A and type-B inserts have a minimum assembly capability of 30 cycles. (auth)

28179 (RN-DR-0028) FLIGHT REACTOR FRAGMENTATION MODEL. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1964. 33p. Dep. NTIS $4.75.

A fragmentation model is developed to estimate the particle size distribution resulting from high altitude destruction of a nuclear reactor. Previous work is reviewed and the results are compared with the new model. (auth)

28180 (RN-DR-0029) BALL BEARING THRUST REVERSAL FEASIBILITY TEST. Allen, C. W.; Ford, O. I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1964. 21p. Dep. NTIS $4.25.

A series of tests was conducted on a thrust bearing and two roller bearings to determine the effects of zero radial load and reversing thrust load on bearing performance. The results, for an accumulated test time of 5 hours, showed that a ball bearing could operate successfully under the stated conditions both at constant speed and during acceleration and deceleration. This result shows that one or more ball bearings can be used in conjunction with a thrust reversing requirement without the need for spring loading the bearings. Therefore, the maximum thrust carrying capacity of a pair of ball bearings can be utilized in both directions. (auth)

28181 (RN-DR-0033) THERMAL ANALYSIS OF NRX-A2 PRESSURE VESSEL. Westmore, W. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1964. 21p. Dep. NTIS $4.25.

Thermal profiles of the NRX-A2 pressure vessel, resulting from nuclear heating and hydrogen cooling, were generated. Profiles were calculated for the pressure vessel wall, forward flange (section between and through the bolts), and the forward dome (control drum and instrumentation boss). The thermal profiles represent conditions at the end of the maximum-power hold. The thermal profiles were generated by computer calculations. (auth)

28182 (RN-DR-0040) STEADY STATE THERMAL ANALYSIS OF NRX-A3 PRESSURE VESSEL. Westmore, W. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1964. 20p. Dep. NTIS $4.00.

For use in stress analyses, steady state thermal profiles of the NRX-A3 pressure vessel, resulting from nuclear heating and hydrogen cooling, were generated. Profiles were calculated for the pressure vessel wall, forward flange (section between and through the bolts), and the forward dome (control drum and instrumentation boss). The thermal profiles were generated by computer calculations. (auth)

28183 (RN-DR-0059) MANAGEMENT CONTROLS FOR NRX/EST TESTING. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1935. 52p. Dep. NTIS $5.75.

For the NRX/EST testing in Test Cell "A", the Management Controls specified in the SAR (WANL-TNR-148) for normal NRX testing have been modified. For the duration of the NRX/EST test program, the material in this report supersedes chapter II of WANL-TNR-148 in its entirety. (auth)

28184 (RN-DR-0060) SUGGESTED ANALYSES IN SUPPORT OF A TUNGSTEN DEMONSTRATION REACTOR FOR THE ARGONNE NATIONAL LABORATORY. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1965. 42p. Dep. NTIS $5.25.

A plan for the development of a tungsten fast nuclear reactor is presented to Argonne National Laboratory, which has suggested such a reactor for space purposes. It is assumed that a prototype would be built and then tested at the Nuclear Reactor Development Station. A rather small reactor is proposed first in which reactor start up, reactor shutdown and steady state performance could be studied. Later a larger reactor could be built with engine components. Attention is called to higher cooldown power and longer cooldown time requirements for a fast reactor (as compared to NERVA) and to controls and instrumentation requirements. Possible test stand modifications are discussed. Various alternative plans are discussed briefly. (LTN)

28185 (RN-DR-0066) NRX/EST OPERATION PROCEDURE FOR INSTRUMENTATION INSTALLATION, ELECTRICAL HOOK-UP, AND CHECKOUT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1965. 26p. Dep. NTIS $4.50.

Instructions are provided for receiving inspection, installation, and electrical checkout of the Instrumentation System from the transducers to the Test Car Plug and the first terminal board in the ELR of Test Cell "A". (auth)

28186 (RN-DR-0077) COMPARATIVE SURVEY OF ADVANCED NUCLEAR PROPULSION CONCEPTS FOR PRIMARY NEAR-SPACE PROPULSION. Stewart, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1966. 70p. Dep. NTIS $6.50.

A comparative survey of advanced nuclear propulsion concepts capable of providing near-space primary propulsion is presented. The concepts discussed include the fluidized bed, liquid core, jet-driven vortex, coaxial flow, glow-plug, MHD-driven vortex, and gaseous core-MHD accelerator nuclear rocket concepts. The discussions, which are based entirely upon existing information contained in the unclassified literature, include brief descriptions of each concept. Advantages, disadvantages, and potential problem areas are identified and discussed. The current status of each concept is discussed, general areas of future effort are cited, and comparisons between the concepts are made. An effort has been made to evaluate the development promise of each concept. (auth)

28187 (RN-DR-0095(Rev.C)) ASSEMBLY PROCEDURE FOR THE EXPERIMENTAL ENGINE ONE AT AGC-SACRAMENTO. Revision C. Sandberg, H. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 12 May 1967. 32p. Dep. NTIS $4.75.

28188 (RN-DR-0103(Vol.1)) NERVA ENGINE DEVELOPMENT PROGRAM PLAN. Summary, Volume I. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 94p. Dep. NTIS $7.75.

Declassified 6 Jul 1970.

This program plan defines the effort proposed for the continuation of the Aerojet-General Prime Contract portion of the NERVA development program in contract years 1968-1975 inclusive. The activities in this 8-year program plan include: (a) the completion of the technology program through testing of XE-2 and NRX-A7 and (b) the development of the NERVA engine through PFRT tests and completion of two deliverable engines. The Aerojet program plan is presented in six volumes and represents a continuation of the NERVA development activity started in 1961 under Contract SNP-1. Events of major significance in this KIWI/NERVA technology development program have included the direct feeding of liquid hydrogen to a reactor test assembly, demonstration of the structural soundness and operating durability (30 minutes at chamber temperature of 4090°R) of the reactor, and successful operation of the hot-bleed-port nozzle and the turbopump assembly. A total of four NRX reactor power test series have been completed to date. An item of major significance was the successful demonstration of the feasibility of the hot bleed nuclear engine cycle utilizing a breadboard engine test assembly (NRX/EST). As a necessary corollary to the end-item development described above, both facilities and supporting equipment have been, and will continue to be, created. Test facilities have been modified to test 55,000-lb thrust engine components such as nozzles, turbopumps and valves and existing facilities constructed for the KIWI program have been modified to permit reactor and engine testing. A number of proposed projects have been described in some detail. (auth)

28189 (RN-DR-0103(Vol.3)) NERVA ENGINE DEVELOPMENT PROGRAM PLAN. Volume III. Program Plan. Book 4. Management Networks. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 130p. Dep. NTIS $9.50.

NERVA program plan management networks are presented which describe the activities, logic, and span times required to accomplish various projects of the NERVA engine development program. (auth)

28190 (RN-DR-0103(Vol.3)(Bk.5)) NERVA ENGINE DEVELOPMENT PROGRAM PLAN. Volume III. Program Plan. Book 5. Management Networks. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 111p. Dep. NTIS $8.75.

NERVA program plan management networks are presented which describe the activities, logic, and span times required to accomplish various projects of the NERVA engine development program. (auth)

28191 (RN-DR-0122(Rev.A)) NERVA SUPPORT EQUIPMENT OPERATING AND MAINTENANCE INSTRUCTIONS FOR TURBINE EXHAUST NOZZLE CLOSURE, 4108. Revision A. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1968. 16p. Dep. NTIS $4.00.

The Turbine Exhaust Nozzle Closure is used in the E-MAD Building and ETS-1 at the Nuclear Rocket Development Station (NRDS) to complement other equipment in performing XE Engine Leak Checks after final assembly and prior to a test firing. This manual provides operating and maintenance instructions. (auth)

28192 (RN-DR-0124) PNEUMATIC INSTRUMENTATION LINES AND THEIR USE IN MEASURING ROCKET NOZZLE PRESSURE. Samuelson, R. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1967. 137p. Dep. NTIS $10.00.

Engine control input requirements for the NERVA NRX/EST test series included a need for accurate nozzle chamber pressure information. However, the nuclear radiation environment at the proposed measurement station (convergent nozzle wall) exceeded the performance limits of available pressure transducers. Thus, it became necessary to develop a remote pressure-measurement system incorporating pneumatic tubing. A pneumatic instrumentation line can be used to couple pressure transducers to a pressure source that originates within an environmental region that exceeds the transducer design tolerance. A pneumatic line also provides a means for obtaining pressure measurements when mechanical interface problems prevent direct coupling of the transducer to the pressure source. However, pneumatic lines have undesirable transfer function characteristics (attenuation and time delay of pressure information) that must be understood and accounted for. Comparison of theoretical formulas with experimental results has shown that the response characteristics of pressure-measuring systems can be predicted with an uncertainty of less than 5% through a spectral range that extends from 1 to 2000 Hz when: Circular instrumentation lines are used; the internal radius of the line is small when compared with its length; the amplitude of pressure oscillations presented to the line entrance is small enough to insure laminar flow throughout the line length; and an elastic gas is assumed where $1.0 > \mu/c\rho D$ and the source frequency is such that $1.0 > \omega\mu/\rho c^2$. By assuming the above boundary conditions, the following three important line configurations have been analytically described: the continuous line configuration, the volume terminated configuration, and the infinite-line configuration. Of the three configurations, the infinite-line is the most versatile, has the greatest potential for enabling accurate pressure information to be obtained with pneumatic tubing, and is the one adopted to meet NRX/EST pressure measurement requirements. Pneumatic lines should be eliminated whenever possible and the transducer coupled directly to the pressure source, but when pneumatic tubing must be used, both steady-state and transient pneumatic line response can be improved by using the largest practicable inner line radius, the smallest obtainable transducer cavity volume, and the shortest feasible line length between the transducer and the pressure source. (auth)

28193 (RN-DR-0133) SYSTEM-ORIENTED NPSP OPTIMIZATION STUDY. Pasternak, T.; Fairall, R. S. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 86p. Dep. NTIS $7.50.

The method of analysis and the results of calculations of weight reduction in a three-stage Earth-to-Mars vehicle for 1982 manned stop-over mission are presented. Significant reductions in weight can be achieved by changing from a conventional propellant feed system requiring a positive suction head for satisfactory operation, to a zero NPSP system with a pump capable of operation with saturated propellant at tank discharge. A potential reduction of about 100,000 lb in the vehicle weighing initially about 1.93×10^6 lb is indicated if a zero NPSP system is substituted for a positive system. The penalty for positive pumping is mainly due to the large amount of propellant (2% to 4%) that cannot be used by the pump because of excessive vapor pressure increase resulting from nuclear heating. In addition, this penalty may increase significantly for the positive NPSP system if the heating rate exceeds that for which shield weight was selected. Studies have also shown that with either the positive or zero NPSP pump, vehicle weight is affected by the shield weight, tank pressure, and vent pressure selection. Generally, a positive pump system requires heavier shielding, higher tank pressure, and lower vent pressure than the zero NPSP system. An analytical procedure that enables selection of the optimum combination of tank maximum pressure, tank prefire pressure, shield weight for the reference vehicle configuration, and a choice of turbopump type are described in detail. (auth)

28194 (RN-DR-0151) SERIES-PARALLEL COMPENSATION FOR XE TPCV ACTUATOR. Schenz, R. F. Jr. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Oct 1968. 38p. Dep. NTIS $5.00.

The Bendix Model NT-D1, SN 17 and SN 18, Turbine Power Control Valve (TPCV) Actuator System was tested extensively

and met the criteria established. However, the nonlinear actuator dynamics, together with the wide load range of the TPCV, impose severe performance requirements on the compensator furnished with the actuator. It is difficult to maintain specified performance under varying load conditions with conventional feedback controls; improved performance can be achieved by placing a frequency-sensitive compensator in the feedback path, in addition to the forward compensator. This concept was applied to the TPCV actuator system. The design procedure and test evaluation are presented. The TPCV actuator system demonstrated marked improvement in performance, particularly on threshold and low-frequency performance, under all load conditions and ambient and cryogenic temperature environments when operated with the compensation design described herein. Reproducibility of performance by this compensation design has been demonstrated by using it with two different actuators (SN 17 and 18). (auth)

28195 (RN-DR-0151(Pt.1)(Suppl.1)) SUPPLEMENT I. ETS-1 Modification for 75K NERVA. NERVA Altitude-Simulation System, Trade-Study Report. Part I. Technical Discussion. DaVolio, J. R.; Unger, R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1969. 133p. Dep. NTIS $9.75.

The trade study re-evaluates the concepts and design approaches required to define an optimum NERVA altitude-simulation system (NASS) and has been necessitated by refinements in analyses, requirements, and changes in engine parameters defined in the latest issue of the NERVA Program Requirements Document (PRD), dated 5 Jun 1968. The basic conceptual design for the wet and dry duct elbows was accepted from previous studies for the present ETS-1 NES and from E/STS 2-3 studies. This study was directed at modifications affecting specific sizing to the 75K-NERVA engine, NASS performance variations with requirements variations, and the cost impact of these variables. The basic purpose was to evaluate cost and reliability as functions of NASS performance. (auth)

28196 (RN-DR-0177A(Vol. 3)) DESIGN REQUIREMENTS SHEETS: PUMP DISCHARGE CHECK VALVE, PUMP DISCHARGE CHECK VALVE AND ACTUATOR, AND BYPASS BLOCK VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1970. 152p. Dep. NTIS $10.75.

Design criteria and performance requirements are presented for the pump discharge check valve and actuator and the bypass block valve and actuator for the NERVA engine. (JWR)

28197 (RN-DR-0177A(Vol.7)) DESIGN REQUIREMENTS SHEETS: TURBINE BYPASS LINES, TURBINE DISCHARGE LINE, AND TURBINE INLET LINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1970. 162p. Dep. NTIS $11.25.

Design criteria and performance requirements are presented for the turbine bypass lines, turbine discharge line, and turbine inlet line of the NERVA engine. (JWR)

28198 (RN-DR-0178) DESTRUCT SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 47p. Dep. NTIS $5.50.

The Design Requirements Sheets cover the destruct subsystem as described in the NERVA Engine Specification Tree, AGC Drawing 1137101, "E" Change. The sheets are organized into two principle categories: Design requirements criteria generated externally (e.g., environments) to the component; and component functional performance requirements. (auth)

28199 (RN-DR-0179A) DESIGN REQUIREMENT SHEETS FOR THE NOZZLE-ASSEMBLY SUBSYSTEM, EC 90151. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. Contract SNP-1. 151p. Dep. NTIS $10.75.

The Design Requirements Sheets cover the Nozzle Assembly Subsystem, EC 90151, and its associated components as described in the NERVA Engine Specification Tree, AGC Drawing 1137101G. The sheets are organized into two principal categories: design requirements criteria generated externally (e.g., environments) to the component; component functional performance requirements for steady state, startup, throttling, shutdown, and cooldown operations; and functional performance requirements of a general nature. Where applicable, functional performance requirements are provided for both normal and malfunction operating conditions. Design Requirements Sheets have been prepared for the following: Nozzle assembly subsystem, nozzle, and nozzle extension. (auth)

28200 (RN-DR-0180) INSTRUMENTATION-AND-CONTROL SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 211p. Dep. NTIS $13.75.

The Design Requirements Sheets cover the instrumentation and control subsystem as described in the NERVA Engine Specification Tree, AGC Drawing 1137101, "E" Change. The sheets are organized into two principle categories: Design requirements criteria generated externally (e.g., environments) to the component; and component functional performance requirements for steady state, startup, throttling, shutdown, and cooldown operations. Requirements are provided for both nominal and malfunction performance conditions. (auth)

28201 (RN-DR-0181) THRUST-STRUCTURE SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 151p. Dep. NTIS $10.75.

The Design Requirements Sheets cover the thrust structure subsystem as described in the NERVA Engine Specification Tree, AGC Drawing 1137101, "E" Change. The sheets are organized into two principal categories: design requirements criteria generated externally (e.g., environments) to the component; and component functional performance requirements for steady state, startup, throttling, shutdown, and cooldown operations. Requirements are provided for both nominal and malfunction performance conditions. (auth)

28202 (RN-DR-0184) PRESSURE-VESSEL-AND-CLOSURE SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 64p. Dep. NTIS $6.25.

The Design Requirements Sheets cover the pressure vessel and closure subsystem as described in the NERVA Engine Specification Tree, AGC Drawing 1137101, "E" Change. They are organized as follows: Design requirements criteria generated externally (e.g., environments) to the component; and component functional performance requirements for steady state, startup, throttling, shutdown, and cooldown operations. Requirements are provided for both nominal and malfunction performance conditions. The sheets provide the basic data for component specification preparation. (auth)

28203 (RN-DR-0185A) DESIGN REQUIREMENT SHEETS FOR THE NUCLEAR SUBSYSTEM, CP 677555. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 158p. Dep. NTIS $11.00.

Design criteria and performance requirements are presented for the nuclear subsystem of the NERVA engine. (JWR)

28204 (RN-DR-0186) CONCEPTUAL SYSTEMS, ENGINEERING PLANNING. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Nov 1969. 26p. Dep. NTIS $4.50.

Specifications are presented for various functions to be performed in the NERVA program. (JWR)

28205 (RN-DR-0187) NERVA ENGINE, 75,000-LB. THRUST, FULL FLOW. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 85p. Dep. NTIS $7.25.

The Design Requirements Sheets cover the NERVA Engine, 75K Full Flow as described in the NERVA Engine Specification Tree, AGC Drawing 1137101, "E" Change. The sheets are organized into two principal categories: design requirements criteria generated externally (e.g., environments) to the component; and component functional performance requirements for steady state, startup, throttling, shutdown, and cooldown operations. Requirements are provided for both nominal and malfunction performance conditions. (auth)

28206 (RN-FM-0001) NERVA PROGRAM. Test Cell A Familiarization Manual. (NERVA Test Operations, Mercury, Nev. (USA)). 1 Jun 1963. 70p. Dep. NTIS $6.50.

Test Cell A at NRDS is described from the facility standpoint: cryogenic system, gas systems, dewar deluge and sprinkler hydraulic systems, compressed air system, vacuum systems, flare systems, water cooling systems, room inerting systems, and turbopump. (DLC)

28207 (RN-FOP-0012) NERVA PROGRAM. Test Cell A Reactor Shed Operation. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Jun 1963. 10p. Dep. NTIS $4.00.

Instructions are provided for the operation of movable reactor shed at Test Cell "A", which can be locally or remotely controlled for removal during tests and replacement after the test (when the area is radioactive). (LTN)

28208 (RN-NC-0014) EXPERIMENTAL AND ANALYTICAL STUDY OF A FLUIDIC CHAMBER-PRESSURE CONTROL SUBSYSTEM FOR THE NERVA ENGINE. Boyd, D. D. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jan 1968. 176p. Dep. NTIS $12.00.

The feasibility of using fluidic devices in the chamber-pressure control subsystem loop on the NERVA engine has been investigated. The task was divided into six parts that were accomplished in series as follows: (1) literature search; (2) evaluation of purchased fluidic elements and of the general state of the art; (3) design, manufacture, and test of vortex- and beam-type devices; (4) a study of engine-imposed pressure requirements on a vortex turbine power-control valve; (5) compilation

of static and dynamic performances of vortex valves and of static performance of beam amplifiers; and (6) initial study of overall dynamic performance requirements for an all-fluidic chamber-pressure control subsystem. A fluidic approach to the NERVA-engine chamber-pressure control subsystem (loop) was investigated. The static and dynamic performance characteristics of selected major fluidic components were demonstrated by experimental and analytical techniques. Preliminary fluidic-component staging was demonstrated, and initial dynamic studies of the chamber-pressure control loop of the NERVA control system were accomplished. Results indicated the total feasibility of synthesizing such a control subsystem. (auth)

28209 (RN-NC-0022) LIGHTWEIGHT NUCLEAR ENGINE CONCEPT. Revised October 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 25p. Dep. NTIS $4.25.

The results of a study conducted to identify the significant design features of an advanced solid-core nuclear rocket engine having a thrust of 75,000 pounds are reported. Particular emphasis is placed on a high thrust-to-weight ratio design based on a logical extension of current solid-core nuclear rocket technology. Such an engine would be useful for many aspects of space exploration, particularly in applications requiring rapid accelerations in high gravity fields. The design is characterized by a short-coupled arrangement using a single turbopump assembly to transfer hydrogen from the propellant tank to the engine. The nuclear subsystem incorporates the concept of in-core moderation, combining the support plate with the internal shield, and utilizing a cold end graphite reflector. These features have been adapted from current technology in the NERVA, Phoebus, and Pewee Programs. (auth)

28210 (RN-PA-0005) STUDY OF THE FUTURE UTILIZATION OF ETS-1. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 Oct 1965. 53p. Dep. NTIS $5.75.

Declassified 23 Aug 1967.

Recommendations are made to continue testing in ETS-1 for the NERVA program and for other tests. (DLC)

28211 (RN-PA-0020) SEMINAR/WORKSHOP MATERIAL ON KERNEL TECHNIQUES FOR NUCLEAR ROCKET PROPELLANT TANK GEOMETRY/SHIELDING ANALYSES. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 18 Aug 1969. 182p. Dep. NTIS $12.25.

28212 (RN-PA-0022) NASS PRELIMINARY DESIGN PRESENTATION FOR HOT-BLEED ENGINE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 8 Oct 1969. 122p. Dep. NTIS $9.25.

NASS stands for NERVA Altitude Simulation System. The design includes duct, ejector, turning plenum, water injection system, secondary ejector, steam ejector, etc. (DLC)

28213 (RN-PA-0024) MATERIAL PRESENTED TO SNPO IN SHIELDING TRADE STUDY REVIEW. Warman, E. A.; Koebberling, K. O. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 23 Oct 1969. 84p. Dep. NTIS $7.25.

28214 (RN-PA-0026(Vol.2)) MATERIAL PRESENTED BY WESTINGHOUSE ASTRONUCLEAR LABORATORY TO SNPO-C ON COMPLETION OF TASKS III AND IV OF SHIELDING TRADE STUDY. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 22 May 1969. 47p. Dep. NTIS $5.50.

The additional radiation attenuation produced by heavier shields was calculated, presented at a briefing and documented. (LTN)

28215 (RN-PA-0028(Vol.1)) MATERIAL PRESENTED TO SNPO IN SHIELDING TRADE STUDY REVIEW. Volume I. Warman, E. A.; Courtney, J. C. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 12 Dec 1969. 84p. Dep. NTIS $7.25.

28216 (RN-Q-0045) QUARTERLY PROGRESS REPORT NO. 45 FOR SECOND QUARTER, CY 1968 COVERING THE PERIOD OF JANUARY, FEBRUARY, AND MARCH 1968. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Apr 1968. 265p. Dep. NTIS $16.25.

The NRX-A6 disassembly was completed on 27 February 1968. Postoperative examination of the test article has been essentially completed. Analysis indicates that the reactor operated at or above the designed temperature for 60 minutes without severe degradation of the core elements. The final pre-cold flow testing of the XECF engine assembly was completed at ETS-1. Cold-flow testing is scheduled to start early in April 1968. Disassembly, clean-up, and reassembly operations of the XE-1 engine continued at NRDS. Testing is scheduled for September 1968. XE-2 UTSM assembly continued at Sacramento and is 90% complete. Aerojet-proposed NERVA technical and programmatic requirements were submitted to SNPO-C on 29 February 1968. Trade-off studies have been performed for the 75,000-lb-thrust engine to determine the relative sensitivity of various parameters in their effect on engine system performance. Other design, testing and development results are reported. (auth)

28217 (RN-Q-0046) QUARTERLY PROGRESS REPORT NO. 46 FOR THIRD QUARTER, CY 1968 COVERING THE PERIOD OF APRIL, MAY, AND JUNE 1968. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jul 1968. 301p. Dep. NTIS $18.25.

XECF was subjected to a successful cold-flow test on ETS-1 on 11 April 1968, after which it was transferred by the EIV to the E-MAD cold bay for external UTSM modification. Subsequently, the XECF has been transferred to E-MAD hot bay, where a remote-cycle demonstration of removal and replacement of the UTSM will be accomplished. The XECF UMA will be returned to Sacramento next quarter for upgrading to the XE-1 configuration. Assembly of the XE-1 is continuing at NRDS, and the XE-2 UMA is being held at Sacramento until all readiness review items have been completed. SNPO-C provided a program requirements document (PRD) for the NERVA engine to Aerojet-General on 3 May 1968 for a 750,000-lb-thrust engine. This document was reviewed, discussed with SNPO and SNPO-C on 5 June 1968, and is being used as the program requirements baseline for the NERVA Program. As a result of the NERVA Task Force activities and the PRD, definitive programs were started to resolve the following major problem areas that are required for definition of the NERVA engine: crew shielding, turbopump selection, and thrust spoiling. (auth)

28218 (RN-Q-0048) QUARTERLY PROGRESS REPORT NO. 48 FOR FIRST QUARTER, CY 1969, COVERING THE PERIOD OF OCTOBER, NOVEMBER, AND DECEMBER 1968. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Feb 1969. 246p. Dep. NTIS $15.50.

Progress in the NERVA engine development program during the quarter is reported. (JWR)

28219 (RN-S-0041) ON-STAND HOT-MAINTENANCE FOR TEST CELL "A" AND ENGINE TEST STAND NO. 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1963. 80p. Dep. NTIS $7.00.

An analysis of on-stand maintenance problems for NRX Assemblies at Test Cell "A" and ETS-1, is presented including an evaluation of the feasibility of designing equipment for performing on-stand inspection, diagnosis, and repair or replacement. Report data is confined to the instances where on-stand hot-maintenance procedures may be more advantageous than the normal process of returning the reactor or engine to the MAD building for maintenance activity. In many cases on-stand hot-maintenance is not regarded as being feasible on account of radiation or lack of special equipment at the test stand. Each problem should be analyzed with regard to: (1) the system capability to detect and identify the problem; (2) space limitations inherent in the reactor or engine; (3) space limitations due to the test installation; (4) radiation field limitations; (5) safety restrictions; (6) on-stand operational procedures; (7) MAD Building operational procedures; and (8) a comparison of on-stand and MAD Building procedures. It is also recognized that on-stand hot-maintenance may be preferable, or even necessary, for some problems. (auth)

28220 (RN-S-0109(Rev.)) EVALUATION TESTING OF BENDIX NT-C2 SERIES TPCV ACTUATORS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1965. 59p. Dep. NTIS $6.00.

The development status of Bendix Turbine Power Control Valve (TPCV) Actuators of the NTC-2 series design based upon test results obtained between October 1963 and April 1964 is presented. The NTC series actuators are the first designed to withstand the high mounting flange and dynamic seal gas temperatures required for the final design. The required performance of the actuator is summarized. The high temperature and thermal shock performance of the Bendix NT-C2 Actuator is very good. For cryogenic endurance and vibration the NT-D1 design will have significant improvements; (1) the modified dynamic seal, and (2) the side by side placement of the servo-valve-torque-motor assembly and the gear-motor-potentiometer assembly, which is a far more rigid mounting arrangement than previously used. The operating response and associated performance are quite satisfactory. The NT-G2 Actuators exhibit very small load variation and gas temperature sensitivity. The problems remaining with the NT-C2 actuators have been considered in NT-D1 design and are not expected to be present in that actuator configuration. It is strongly recommended that actuators of this design be constructed and

tested. A short radiation test program should be conducted with an NT-C2 actuator with a combined environment such as: radiation, actuator-loaded, cryogenic supply gas, and pressurized seal cavity. Such a test will yield much more information about the actuators' level of development than a separate radiation test with no load, etc., as was performed for first investigation with an NT-B actuator. (auth)

28221 (RN-S-0150(Vol.1)) XE-PRIME ENGINE, FINAL REPORT. Volume I. Engine and Facilities Description. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Dec 1969. 332p. Dep. NTIS $19.75.

The XE-Prime engine was the first nuclear rocket engine to be tested with components in a flight-type, close-coupled arrangement. The general objective of the test series was to further extend nuclear rocket technology in preparation for a flight system and to operate the test facility under nuclear firing conditions. A description of the engine and test facilities (with detailed photographs and diagrams) is provided. This is required for an understanding of test operations and results reported in Volumes II and III. (auth)

28222 (RN-S-0150(Vol.3)(Bk.2)) XE-PRIME ENGINE, FINAL REPORT. Volume III, Book 2. Test Data Analysis, Startup Systems. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 483p. Dep. NTIS $27.25.

The XE-Prime engine was the first nuclear rocket engine to be tested with components in a flight-type, close-coupled arrangement. The general objective of the test series was to further extend nuclear rocket technology in preparation for a flight system and to operate the test facility under nuclear firing conditions. Several approaches to startup were tested during the XE-Prime test series. The various types of startup are described and a brief discussion of design analysis and of startup testing over a wide range of initial conditions is provided. In addition, the objectives and results of critical position and preconditioning tests are discussed. Initially, test objectives were based upon power operation starting from essentially ambient conditions. As the program developed, emphasis was shifted to include startup evaluation over a wide range of "off-ambient" conditions. The change of emphasis and continued work resulted in an evolution of the experimental "wet" and "dry" autostart design concepts to an engine autostart(EAS) concept which combined the best features of the two experimental concepts and provided all capabilities expected to be required for the NERVA engine. (auth)

28223 (RN-S-0202) BASIC ANALOG MODEL FOR X-E, EST, AND CFDTS TURBOPUMP AND TPCV. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1965. 20p. Dep. NTIS $4.00.

Technical information is presented detailing the development of the turbopump and TPCV simulation equations and the simplifications made for analog computer programming. The feed-system is described by equations for the pump head rise, the diluent bleed, the turbine power control valve line and pressure drop, the turbine torque and flow line, the pump torque, and the pump speed. The dynamics for the pump and the line are added to the dynamics of the basic engine which is described in Reference (1). The coupled dynamics define the above named systems. The accuracy of the equations in describing the real system is best near the full power condition. Low speed turbine characteristics are not completely defined by available data and are difficult to predict. Therefore, the least accuracy occurs in predicting low speed, low turbine-flow conditions. The fluid conditions during chill-down may be inaccurate because a simplified description of the two-phase flow and heat transfer is used. (auth)

28224 (RN-S-0203) STEAM GENERATOR SYSTEM DEVELOPMENT TEST PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1965. 52p. Dep. NTIS $5.75.

The NERVA Exhaust System for ETS-1 at NRDS will provide a steam safety purge for engine start-up, shutdown, or engine malfunction during the engine test. To avoid accumulation of an explosive mixture of hydrogen gas and air within the engine compartment or exhaust system, the ambient air must be removed prior to engine start. This will be accomplished by displacement of the air with a nitrogen gas purge and an aerodynamic check valve to prevent re-entry of air into the exhaust duct or engine compartment during the test sequence. The function of the steam generator is to supply steam as the operating medium to an ejector located in the exhaust duct which operates as the check valve. The primary objective of the Steam Generator Development Test Program will be to determine the best means for efficient operation of the steam generators when integrated and operated as a system. In addition, final modifications and refinements will be made to the generators, the test stand and the control system to insure safety and maximum system reliability. Secondary objectives will be to provide test operations personnel with actual operating experience prior to ETS-1 activation and to establish expected life cycle of major components of the SGS in order to determine spares requirements. (auth)

28225 (RN-S-0219) XE EXTERNAL SHIELD DESIGN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1965. 71p. Dep. NTIS $6.75.

The Hot Bleed Nuclear Reactor Experimental Engine (XE) is a ground-test version of the NERVA series. To facilitate testing and expedite achievement of the test program objectives, an external radiation shield is incorporated in the XE design to provide reduced levels of radiation in the upper thrust structure (UTS) area of the engine. This permits the use of non-radiation proven components in the UTS, e.g., turbine-pump assembly, control drum actuators and the various fluid and pneumatic valves. The external shield design incorporates a basic aluminum structure, 102 inches in diameter and 16.5 inches in height. Contained within the structure are three radiation attenuation levels, two upper layers of stainless steel balls and borated water and one layer of borated water alone. The steel balls provide gamma ray absorption while the borated water provides neutron shielding. The shield design also incorporates penetrations for the various engine system fluid and pneumatic lines, control drum rods and instrumentation lines. The design criteria established for the shield and the description of the preliminary design are presented. Preliminary corrosion, radiation, thermal and structural analyses are presented as well as operational considerations and fabrication methods. (auth)

28226 (RN-S-0241) NRX-A3 SIDE-BY-SIDE RADIATION EFFECTS TEST. Final Test Report. Kneeland, D. G. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1966. 102p. Dep. NTIS $8.25.

The results of Radiation Effects Test 23/R005 (accelerometers) are described. It was conducted concurrently with the NRX-A3 test series during April and May 1965. Of eight accelerometers tested, two were Statham Model A519 (unbonded strain gage), three were Clevite Model 25D21X (piezoelectric), and three were Gulton Model CQ440504 (piezoelectric). The test assembly was positioned to the north of the NRX-A3 test car in an area where the maximum gamma dose rate was 4×10^{10} ergs/gm(C)-hr. Upon completion of the test series the total gamma dose was 2×10^{10} ergs/gm(C): total fast neutron (E > 1.0 MeV) exposure was 1.7×10^{16} neutrons/cm^2. All accelerometers operated throughout the test series. However, test results give no clear indication of the superiority of either the strain gage or the piezoelectric accelerometer for use in measuring vibration in a nuclear radiation environment of the type experienced adjacent to NRX-A3. The possibility that rate effects would distort or "swamp-out" the high impedance piezoelectric output signal was not realized. The most significant error source encountered in the use of both basic types of transducers was sensitivity variation with changing temperature. Sensitivity variations were noted but in all cases the direction of change was that which would be expected from the concurrent temperature change. The Stathams decreased in sensitivity with increasing temperature while the Clevites increased in sensitivity. Temperature changes were primarily attributable to gamma dose rate. (auth)

28227 (RN-S-0244) AEC–NASA SPACE NUCLEAR PROPULSION OFFICE X-ENGINE PERFORMANCE ANALYSIS. Stiger, R. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1965. 72p. Dep. NTIS $6.75.

Analyses performed in support of the X-Engine are summarized. An up-to-date design point performance is maintained for the X-Engine using the latest component data as they become available to assure component interface and acceptable engine performance. Steady-state operating and component constraints are also calculated in the form of a steady-state operating map to give a clear picture of the safe operating limits of the engine and the applicable component limits. Along with steady-state engine maps, parametric studies are performed to define component operating conditions. To define the X-Engine performance under dynamic conditions, transient analyses are made of the system. These studies include analyses of startup, shutdown, and cooldown. One of the more critical transient areas studied in detail is that of emergency or fast cooldown. The fluid requirements tailored to the ETS-1 facility capability were computed for Fast Shutdown, Emergency I, and Emergency II conditions. Also, a model has been developed to study the dynamics of the facility (ETS-1) to determine the propellant availability in regard to both pressure and quantity. Finally a study has been made to determine possible increased operation scope for the X-Engine. (auth)

28228 (RN-S-0247) NRX/EST DATA ANALYSIS PLAN. Fenech, E. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1965. 36p. Dep. NTIS $5.00.

The Data Analysis Plan for the NRX/EST series is described. The NRX/EST series of tests is the next major experimental stepping stone leading toward the development of a self-contained nuclear rocket. For the first time, the reactor will be operated with hydrogen feed supplied by a turbopump system operated by hot gases exiting from the core. The test is expected to take place early in CY '66. The Data Analysis Plan has been based on the premise that the principal objectives are: To determine the degree to which the formal test objectives have been met in each test; to compare the actual experimental measurements with the predictions explaining, where possible, major deviations; to provide information allowing the upgrading of the analytical models of components based on the system test; and to thoroughly analyze unexpected test occurrences, such as emergency shutdown procedure or component failures. In addition to these technical objectives, an important administrative objective is recognized, i.e., to coordinate the activities of all groups to ensure that all aspects of the NRX/EST series are considered and that there is a minimum duplication of effort. This is accomplished by describing the tools (computer programs) to be used, defining the reports to be prepared and identifying the organization responsible for each. (auth)

28229 (RN-S-0248) ENGINE SYSTEM SIMULATION PROGRAM (364). Fenech, E. J.; Slonim, N. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1966. 59p. Dep. NTIS $6.00.

Changes and additions made in the Engine System Simulator (364) program during the SNP-1 1965 Contract Year are described. The capability of simulating turbopump performance was a major addition to the program. The logic required to match turbopump performance and engine performance was included. Changes necessary to allow choked flow at any location in the engine system were made; previously, choked flow could occur only in the nozzle throat. Additional methods of handling branched flow were developed to be used for simulating diluent and hot bleed lines and other configurations which previously could not be represented. These program developments were made to increase the utility and flexibility of the program. At the end of contract year 1965, the NRX options were operational and the engine system options, although programmed, were in the process of computational checkout. (auth)

28230 (RN-S-0253) ASSEMBLY AND INSTALLATION OF THE NERVA EXHAUST SYSTEM DUCT AT ETS-1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1965. 41p. Dep. NTIS $5.00.

The requirements and procedures for the installation of the NES duct in the ETS-1 are established. The initial duct installation will be made under the cognizance of the duct fabricator in accordance with an installation plan provided by the fabricator. The plan described herein will apply in the event that duct removal becomes necessary and a new duct is installed, or the existing duct is re-installed. The basic information has been incorporated into the ETS-1 NES Duct Final Design Specification 6884. (auth)

28231 (RN-S-0265) OPERATIONAL SUPPORT PLAN XECF ENGINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1966. 130p. Dep. NTIS $9.50.

The systems engineering process is accomplished with two basic documents, the Functional Flow Diagrams and the Support System Functional Analysis. Required activities (e.g., transportation, assembly, checkout, test operations, and posttest operations) are formulated into functions which must be performed by the various elements of the support system. These functions are documented on the Functional Flow Diagrams. The intent of these diagrams is to delineate the logical sequence of operations that must occur from initial engine buildup through transportation, checkout, test, and post-operative examination. They identify major functions to be performed as well as the location where the function will occur. Diagrams are shown to various levels of detail beginning with the top level which consists of operations classified into general categories. The functions described on the top level are subsequently identified in more detail on the lower level diagrams. It is not the intent of the diagrams to provide all information and data required to identify the individual items of support equipment, but to arrange the system requirements in a way which facilitates further analysis and system design. Functional Flow Diagrams are supplemented by the Support System Functional Analysis. The analysis sheets contain the system engineering analysis which translates the systems functions shown on the Functional Flow Diagrams into GSE initial design/performance requirements. (auth)

28232 (RN-S-0273) EVALUATION OF TEST RESULTS FOR PRESSURE TRANSDUCERS AND ACCELEROMETERS. Ground Test Reactor (GTR) Irradiation Test No. 14. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1965. 47p. Dep. NTIS $5.50.

Three pressure transducers, selected for use on NRX-A2, were tested in a combined environment of high temperature, vibration, and radiation that simulated, as far as practical, the anticipated NRX-A2 environment. The test objectives were only partially met because of the failure of the heater element and the vibration shaker during the test. One test sample (S/N 854) failed shortly after the beginning of the test because of a faulty pin connection in the electrical connector on the component. The two remaining transducers (S/N 856 and 857) performed satisfactorily throughout, i.e., demonstrated no neutron rate sensitivity or accumulated neutron effects within the limits of data accuracy for the test. Three piezoelectric accelerometers were irradiated to determine the cumulative dose effects on transducer performance. The intent was to stimulate the accelerometers periodically with a known input during the irradiation period. The objective was only partially achieved because of the failure of the shaker after approximately 60% of the irradiation period and its erratic performance prior to failure. The final assessment of the cumulative dose effects was based on a comparison of pre-irradiation calibration data with data recorded at the Irradiated Materials Laboratory 34 days after the end of the irradiation period. Significant changes in the ceramic element capacitance and charge sensitivity were noted; both decreased approximately 25 to 30 percent. The transducer voltage sensitivity changed only slightly because of the proportional changes in capacitance and charge sensitivity. One transducer failed completely during the test; however, the failure was not caused by radiation since the unit was operating erroneously before the irradiation began. A second transducer operated intermittently during the test and a post-test examination revealed a poor contact between the pin and socket in the radiation-tolerant electrical connector. The third transducer operated satisfactorily throughout the test. The conclusions, for both pressure transducers and accelerometers, were based on a consideration of neutron radiation, since the gamma rates in the Ground Test Reactor were below the level of concern for gamma heating effects expected on NRX-A2. (auth)

28233 (RN-S-0292) MINUTES OF FIRST INSTRUMENTATION REVIEW MEETING, CONTRACT YEAR 1966. Volume I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1966. 117p. Dep. NTIS $9.00.

The project experience with particular measuring instruments (and types of instrument) used for measuring vibrations, strains, pressures, and temperatures are reviewed. In several cases the advantages and disadvantages of a particular type or make of instrument are discussed. Often, the project is concerned with measurement at extreme conditions: very high or very low temperature, in a high radiation environment, large vibrations, etc. so it is often necessary to test new instrumentation designed especially for such conditions. (LTN)

28234 (RN-S-0298) FINAL REPORT CFDTS SERIES I, II, AND III TESTS. Smyth, G. B. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1966. 191p. Dep. NTIS $12.75.

The primary purpose of the program was to verify that engine "bootstrapping" could be initiated by nozzle-chamber bleed to the turbine and to provide data related to the behavior of the NERVA hot bleed engine during startup. Program objectives were achieved. The system successfully "bootstrapped" and useful information was obtained for upgrading and improving the computer models simulating the system as well as for improving the engine system itself. The engine system (which was the first test assembly containing all major engine components to form the full-size NERVA rocket engine with an unfueled reactor assembly), the test facility and the instrumentation used in the conduct of the tests, and the test results are described. (auth)

28235 (RN-S-0302) HEAT TRANSFER DESIGN CRITERIA FOR NUCLEAR ROCKET NOZZLES. Moore, L. C.; Smith, J. R.; Ingram, T. J.; Thompson, W. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1966. 60p. Dep. NTIS $6.00.

The last formal report presenting the results of nozzle analysis in terms of thermal and pressure drop design criteria was published in 1964. Since then, a considerable quantity of data have been generated from scale-model tests, chemical simulation firings, and nuclear (NRX) tests. As these data became available and were applied to current problems, the "state-of-the-art" evolved to encompass the enlarged field of experience. A chronological survey of this evolutionary process in design and prediction philosophy is presented. Chemical simulation testing of NERVA nozzle S/N 021 is then presented in depth. Finally, thermal analyses of the nozzles used on NRX tests A2 and A3 are presented both for qualifying chemical simulation and the reactor tests. The evolution of the currently recommended gas-side heat transfer correlation is shown to be based on boundary layer theory as modified by an empirical C_g factor to account for departures from the idealized flow case. The application of this

approach to chemical simulation testing ($LO_2 - LH_2$ combustion) of a highly-instrumented NERVA nozzle is discussed. Instrumentation problems prevented the acquisition of data required to generate local heat transfer coefficients. Measured coolant temperature profiles closely agreed with those predicted. However, pressure drop predictions required an arbitrary factor to match measured pressure losses. NRX-A2 and A3 tests, together with preliminary simulation tests on these NRX nozzles, are then evaluated in terms of heat transfer and pressure drop correlations. Each test was shown to require individual modifications to the pretest analysis to allow for variations in geometry and test conditions. (auth)

28236 (RN-S-0306) NERVA SUPPORT EQUIPMENT OPERATION AND MAINTENANCE INSTRUCTIONS. Post Operative Cell Materials Transfer System. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 51p. Dep. NTIS $5.75.

The Post Operative Cell Materials Transfer System (POCMTS) forms an integral portion of the complete remote handling capability built into the E-MAD Building at the Nuclear Rocket Development Station (NRDS). The POCMTS consists of two subsystems, the Intercell Transfer Subsystem (ITS) and the Hot Cell Materials Transfer System (HCMTS). Control panels, power panels, and associated wiring and busrails, together with lifting slings, complete the system. The purpose of the POCMTS is to provide transfer capabilities within the Post-Operative complex of the E-MAD Building. The ITS is provided to transfer radioactive components and materials by remote control from, or to, the Core and Engine Disassembly and Examination Cells (CDAE and EDAE), and to, or from, the post-mortem cells through the 30 by 30 inch openings in the cell walls. The HCMTS is provided to support and transfer radioactive equipment, components, and work set-ups by remote control from, or to, the post operative cell service area and to, or from, each of the post mortem cells on existing facility, 56½-in. gage, tracks. (auth)

28237 (RN-S-0307) NRX/EST POST-TEST INSTRUMENTATION REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1966. 101p. Dep. NTIS $8.25.

A total of 207 measurements were made of NRX/EST temperature, pressure, strain, and vibration parameters. Of these, 83% (or 172 measurements) were successful and provided valid test data throughout all Experimental Plans within component design limits and predicted measurements accuracies. Because of intermittent operation for various reasons during portions of the test series, 6% (or 12 measurements) were classified as partial successes only, although the data at other times were valid. The remaining 11% (or 23 measurements) were classified as failures (this number includes all channels inoperative at the end of the test series). Many of the failures occurred as the Experimental Plans were being conducted and valid data were obtained prior to failure. Investigation of the causes of intermittent instrument operation and failure revealed characteristics of the engine operating-environment and of instrument design that previously had been unknown or inaccurately predicted. The cause of the faulty operation of nearly all of the instruments affected was attributed to environmental effects. Information obtained both from the review of test data and from the investigation of the causes of failure has been used to redesign the instruments affected to prevent similar occurrences on future tests. (auth)

28238 (RN-S-0309(Bk.1)) NRX/EST DATA ANALYSIS REPORT. Book I. Glaeser, D. B.; Henschel, A. J.; Slonim, N. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1966. 162p. Dep. NTIS $11.25.

Declassified 13 Aug 1970.

Multiple data analysis plots conceived and generated by REON during the NRX/EST series are presented. These plots have advanced the state-of-the-art in the presentation of data for analysis purposes by: (1) Providing up to seven distinct parameters plotted against control room time per page. With several parameters plotted on a single page, a ready comparison of the performance of the various parts of the engine was made possible. (2) With the multiple plots available, it was possible for the DRAGON team to analyze engine performance by reviewing pertinent data with a minimum of delay and to make recommendations for the next test. (3) Making plots of the entire test time period as in EP-IVA rather than only abbreviated time periods, such as shutdown and startup. (4) Reducing the overall volume of material to be reproduced, distributed, and stored. Because REON Systems Analysis was able to make extensive use of the multiple plots, a much more detailed data analysis report was issued on NRX/EST within the allotted time period. (auth)

28239 (RN-S-0310) XE-1 TEST PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1966. 37p. Dep. NTIS $5.00.

This test plan defines the XE Test Program and serves as a basis for the conduct of the tests. It includes the test objectives, preliminary information on the test runs, assembly, disassembly, post-operative examinations and forms a basis for all test documentation. The XE is a close-coupled, downward-firing, nuclear rocket engine. The major components include a liquid hydrogen propellant feed system consisting of the TPA, lines and pneumatically actuated valves; a regeneratively cooled nozzle; a pressure vessel; a reactor assembly; twelve pneumatic control drum actuators; a lower and upper thrust structure; diagnostic and control instrumentation; engine controls system; and an external shield located between the two thrust structures to protect the non-radiation hardened components. The engine connects to the facility at the Upper Thrust Structure/Test Stand Adapter (UTS/TSA) interface. The test program will be performed at ETS-1, a vertical nuclear rocket engine test stand, which includes the Nuclear Exhaust System (NES) to provide altitude simulation. The XE Program will be the first NERVA Program to utilize a close-coupled downward firing nuclear engine, as well as a test stand and facility designed specifically for nuclear engine testing, including altitude simulation capability. (auth)

28240 (RN-S-0313) NERVA MATERIALS PROGRAM CY 1967. Funk, C. W.; Emmons, W. F. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1966. 57p. Dep. NTIS $6.00.

To place the problems of materials and their processing in perspective, this program plan has been prepared for two viewpoints. The materials problems of specific components of the proposed NERVA engine have been defined under Design Requirements for Materials to ensure identification of all problems and for the information of the design engineer. Since many components have common requirements for materials properties, economical approaches for solutions are discussed under Materials Properties and Process Development for more detailed examination by the materials engineer. The integration and dependence of these components, problems, tests, and objectives has been illustrated in a PERT type network. (auth)

28241 (RN-S-0327) FINAL REPORT ON GTR-17 EFFECTS OF RADIATION ON ORGANIC MATERIALS IRRADIATED IN LIQUID HYDROGEN. Sanders, R. H.; Weleff, W. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1967. 89p. Dep. NTIS $7.50.

Data obtained from the structural materials irradiation test GTR-17 conducted in support of the NERVA project is reported. Five organic materials were irradiated at three radiation levels: Armalon (TFE-405-CL-116), Armalon (TFE-405-L-112), Armalon (FEP-510-L-128), Teflon (FEP), and SP-3 (Superpolymer). These materials were subjected to irradiation levels of: 1.2×10^9, 5.0×10^9, and 3.0×10^{10} ergs/gm (C). The effects of irradiation were evaluated by tensile testing controls and the irradiated specimens at both LH_2 and room temperatures to determine the ultimate stress, strain, and energy at failure. General conclusions are as follows: Irradiation of all materials (except SP-3) in LH_2 resulted in an initial increase in strength followed by an appreciable decrease at the higher radiation dosage. A general trend of significant strength degradation of Teflon and Armalon at 3×10^{10} ergs/gm (C) was apparent. The irradiation at liquid hydrogen temperature produced a marked decrease in elongation following the highest radiation dosage. FEP Teflon exhibited extreme temperature sensitivity and brittleness at liquid hydrogen temperatures. Radiation at liquid hydrogen temperatures still further decreased the elongation at failure. SP-3 was relatively unaffected by the nuclear radiation and test temperature. Three extremes of material response to the test environmental conditions were observed: (1) initial improvement in failure stress and elongation due to LH_2 exposure, with subsequent deterioration due to nuclear radiation as exhibited by the Armalons; (2) continuous degradation produced by the LH_2 radiation exposure, as exhibited by Teflon; and (3) no change due to liquid hydrogen and radiation environments as exhibited by SP-3. (auth)

28242 (RN-S-0341) MODEL SPECIFICATION: TURBOPUMP FOR NERVA TECHNOLOGY ENGINE. Nishioka, T. (Aerojet-General Corp., Sacramento, Calif. (USA)). 30 Sep 1966. 56p. Dep. NTIS $6.00.

This specification establishes the design criteria, performance characteristics, operational limitations, handling requirements and configuration of the turbopump for the NERVA Technology Engine. It is specifically applicable to the Mark III, Mod 4 configuration. The turbopump, at rated conditions, delivers 75 lb/sec of liquid hydrogen at 1000 psi pressure rise from 10 psi inlet conditions and is powered by 7 lb/sec of hydrogen gas at an inlet temperature of 1200°R and pressure of 420 psi, with a pressure ratio of 10:1. The turbopump is capable of 40 minutes of operation at rated conditions, is capable of tank pressure bootstrap start in the engine system and may be started dry without pump chilldown. The turbopump consists of a single stage, radial discharge, integral inducer centrifugal pump directly driven by a

two-stage axial flow impulse turbine. Shaft support is provided by propellant-cooled, rolling element bearings inboard of the overhung impeller and rotors. Thrust balance to within bearing capability of the tandem ball thrust bearings is accomplished by impeller backvanes. Internal instrumentation is provided for assessment of performance and mechanical integrity. (auth)

28243 (RN-S-0352(Rev.C)) XE-1 TEST SPECIFICATION. Revision C. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1968. 29p. Dep. NTIS $4.50.

Specifications for XE-1 engine transportation and installation in the test stand ETS-1 are presented together with required tests of both the XE-1 engine and the test stand. Procedures for cold flow tests and startup tests to intermediate power are discussed, and post-flow test and disassembly specifications are listed. (DG)

28244 (RN-S-0360) STEAM GENERATOR SYSTEM DEVELOPMENT TEST REPORT EP-IV, EP-V, EP-VI. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1966. 166p. Dep. NTIS $11.50.

Phase II (Experimental Plans -IV, -V, and -VI) of the Steam Generator System Development Test Program is described. The program progressed through steps of single module full-steam operation, single module full-steam operation with the other two modules idling, and finally full-steam operation of two modules with the third on standby. It was demonstrated that the system was capable of running with two modules at full-steam for a sustained period of 1100-sec, delivering 124 lb/sec steam at 1300°F through the facility steam-line. The system functioned in a stable manner with no evidence of pressure or temperature fluctuations. The injector fuel-system operating system characteristics were determined, as were the effects of injection water pressure and flow rate. The necessary time delays and proper sequencing of the various system valves also were determined. Some rework of the combustion-chamber expansion joint was necessary to provide an adequate structure. No problems occurred with the reworked joint. After repair of some injector weld seams, the injectors performed well. Only minor deterioration of weld seams was subsequently noted. The work represents the completion of the Steam Generator System Development effort. (auth)

28245 (RN-S-0364) PRELIMINARY DESIGN STUDY OF NERVA ENGINE REMOTE INTERFACES. Ross, G. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1967. 51p. Dep. NTIS $5.75.

Activities related to the design and development of the NERVA Engine Remote Interfaces are described. A modular concept is defined that provides remote assembly and disassembly capabilities for the required components. The basic design guidelines and the remote connector design requirements have been determined. The NERVA Technology Program (XE) remote design was reviewed and defined to ensure maximum applicability to the NERVA Engine remote design. Various concepts for the design of structural and fluid connectors were reviewed. Two concepts describing ways in which the wiring could be made to provide the required remote capabilities are also presented. Several electrical connectors having remote capabilities were reviewed. A tentative selection was made for each type of the required remote connectors. The Marman Conoseal was selected as the remote connector for the large fluid lines. The pressure-balanced, nonlocking, self-sealing fluid coupling was selected for the small fluid lines. The revised electrical wiring concept was selected, utilizing the Amphenol Series 217 as the best available connector with remote capabilities. These connector design concept selections are preliminary. (auth)

28246 (RN-S-0369) NRX-A5 QUALIFICATION TEST OF ENGINE-MOUNTED PRESSURE TRANSDUCERS. Della Villa, L. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1967. 61p. Dep. NTIS $6.25.

Four Statham Model PA812-750-1500-16647 pressure transducers were tested on the NRX-A5 engine for evaluation as a control transducer for use on NRX and XE-1 engines. All four transducers drifted off scale during full-power conditions and had permanent zero shifts. The significant test data indicated that the zero shifts were caused by the transducer diaphragms exceeding their maximum tolerable temperature extreme of 1060°R. Most of the signal degradation was attributed to unsymmetrical shunting of the transducer bridges by extremely low insulation resistances of the cable-connector assemblies. Full-power gamma heating values were approximately 1.26 w/gm(C), and the neutron doses received by the transducers during NRX-A5 tests were 3.18×10^{15} nvt (thermal) and 2.61×10^{16} nvt (fast). On the basis of the test results, the transducers were redesigned to eliminate the transducer connector, reduce transducer length and mass, and improve the heat-sink path for the cables. Thermal analyses of the redesigned transducers show that they should operate reliably for the NRX-A6 and XE-1 tests. (auth)

28247 (RN-S-0372) NERVA MATERIALS DEVELOPMENT FIRST QUARTER, CONTRACT YEAR 1967 (1 OCTOBER–31 DECEMBER). (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1967. 89p. Dep. NTIS $7.25.

Activity was continued in connection with space environment, wear and friction, radiation effects, cold-worked austenitic alloys, turbopump, valves, pressure vessel, nozzle, and facilities. The major technical accomplishments were: (a) The materials wear-test apparatus successfully demonstrated wear-scar and weight-loss correlation under conditions equivalent to 100 mph for 50 mi under a 10-lb load at −423°F, and (b) Thresholds for radiation-induced ductility losses in nozzle-tube materials were defined as neutron doses of 5×10^{17} nvt (thermal) and temperatures above 1000°F. (auth)

28248 (RN-S-0373) OPERATING AND MAINTENANCE INSTRUCTIONS FOR XE-1 TEST STAND CONTROL SYSTEM (TSCS) CHECKOUT SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1968. 146p. Dep NTIS $10.50.

This manual contains the general description, installation, theory of operation, maintenance instructions, and troubleshooting procedure for the Checkout System located in Racks 64, 60, 49, 47 and 45, ETS-1 (Engine Test Stand Number 1), TSCS (Test Stand Control System). Racks 66, 64, 49, 47 and 45 each contain a Checkout Panel, AGC Part Number 1114534-9. Rack 60 contains a similar Checkout Panel but is included in the Analog Patch Board, EAI Drawing Number 04.00502. The checkout equipment is located within racks 64 and 65 in the Test Cell Building. The checkout panel provides an electrical interface for the checkout equipment located in Racks 64 and 65. (auth)

28249 (RN-S-0380) EVALUATION OF E/STS 2 AND 3 SCALE-MODEL DIFFUSER-EJECTOR (WET-ELBOW SYSTEM). Margetts, M. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1967. 91p. Dep. NTIS $7.50.

Scale-model tests were conducted to develop a minimum-length diffuser-ejector design for use in testing 5000- and 10,000-Mw NERVA engines in a simulated space environment. The results of these tests, called "dry-elbow studies" are given in AGC Report RN-S-0379. In association with these studies, auxiliary test series were conducted to derive preliminary information on methods of cooling the walls of the flow-turning elbow in the subsonic portion of the exhaust diffuser system. The methods investigated were: Film cooling, which consists of cooling the flow boundary by injecting water through discrete ports in the elbow wall; stream saturation, which consists of cooling by injecting water directly (both axially and radially) into the hot-gas flow field; and stream penetration, which was investigated to determine the depth of penetration of a water jet directed normal to the hot-gas flow field. The studies led to the general conclusion that elbow cooling by internal (wet) means is indeed feasible; however, further testing is required before quantitative numbers can be predicted with sufficient confidence for the design of full-scale hardware. (auth)

28250 (RN-S-0383) QUALIFICATION TEST FIRINGS OF PHASE II CONTAINMENT CAPSULES AT AEROJET-GENERAL, DOWNEY PLANT. Final Test Report. Voreck, W. E.; Downs, M. E.; Lindberg, E. I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1967. 72p. Dep. NTIS $6.75.

The results of four Countermeasures Radiation Effects Program Phase II capsule qualification tests are presented. These tests were conducted by detonating 160 grams of high explosive in the Phase II capsules and measuring the shock pressures transmitted into the surrounding water media. A maximum of 80 grams of explosive will be irradiated in the Phase II capsule. In addition to test measurements, analytical calculations of the shock wave are compared. Proof of containment of a possible explosion was necessary before the explosives could be irradiated in a reactor. (auth)

28251 (RN-S-0394) ENGINE MAINTENANCE, ASSEMBLY, AND DISASSEMBLY (E-MAD) FACILITY SAFETY REPORT. Wu, M. K.; Booth, H. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 72p. Dep. NTIS $6.75.

The E-MAD facility has been evaluated to determine its adequacy in: protecting personnel from the inherent nuclear hazards associated with handling, assembly, and disassembly operations of the nuclear engine; providing warning and countermeasures in the event of nuclear accidents and fires; preventing accidents which could result in injury to personnel or damage to property; and complying with applicable AEC, or other governmental, safety standards. The physical layout of the facility makes it adequately adaptable for the establishment and maintenance of controls to protect against inadvertent criticality, spread of radioactive contamination, and undue radiation exposure to personnel. The ven-

tilation and waste disposal systems are so designed that the potential for facility contamination by radioactive materials is minimized. Shield Integrity Tests have established the integrity of the shielding enclosing the "hot" areas by disclosing deficiencies which have been subsequently corrected. There are minor void or streaming areas which are not practicable to correct but which can be adequately controlled by administrative procedures. The nuclear detection and alarm systems provided in the building and the Railroad Transport System are of types in standard usage in the nuclear industry and have been found acceptable by experience. The E-MAD facility includes a fire alarm system with provisions for alarm activation at appropriate and easily accessible locations. As with the criticality alarm system, a backup power source to assure continuous operation of the fire alarm system is necessary but has not yet been provided. General support equipment, such as lifting devices, manipulators, stands, etc., are structurally designed to conform to or exceed the standards recommended by the National Safety Council. The integrity of this equipment has been verified by load tests. This equipment incorporates special safety features such as fail-safe mechanisms, redundancies, positive locking systems, and other devices to prevent accidental dropping of critical items or injury to personnel. (auth)

28252 (RN-S-0400(Phase 1)) XE-2 TEST SPECIFICATION. Phase I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1968. 161p. Dep. NTIS $11.25.

Specifications and related information required for the performance of the XE-2 test program in Engine Test Stand No. 1 are presented. (JWR)

28253 (RN-S-0400(Rev. C)) XE TEST SPECIFICATION. Revision C. (Aerojet-General Corp., Sacramento, Calif. (USA)). 11 Jun 1969. 100p. Dep. NTIS $8.00.

28254 (RN-S-0403) PRELIMINARY DEVELOPMENT PLAN FOR NERVA LINES. Shurley, L. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 42p. Dep. NTIS $5.25.

This development plan for NERVA lines and their components defines the development activities to be carried out through design-verification tests before component designs are frozen. All major line assemblies and such components as internally restrained gimbaled bellows, flexible (wire-braided) bellows, seals, and flange-joint couplings are covered. Component descriptions and operating, environmental, and laboratory test conditions are included. The timing of various development phases and the relationship of these phases to the NERVA program are also given. The primary and ultimate objective of this development program is to develop the NERVA-lines system to meet the operational requirements established for each of the major line assemblies. Specifically, this document identifies those aspects of design that depend on test-data feedback and rate verification by tests, introduces the development logic, establishes the sequence of development activities, provides justification for various development events, and defines the events that will furnish acceptable proof that the design requirements have been met. (auth)

28255 (RN-S-0407) NERVA MATERIALS DEVELOPMENTS THIRD QUARTER, CONTRACT YEAR 1967 (1 APRIL–30 JUNE). (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1967. 94p. Dep. NTIS $7.75.

The definition of light missions has emphasized the materials problems in areas such as the effects of the space environment on lubrication and wear of moving parts. The increased radiation resulting from the new engine size and engine clustering has served to emphasize: development of radiation-resistant and wear-resistant retainer materials for turbopump bearings; high-temperature radiation embrittlement of boron-containing, age-hardenable nickel alloys such as Inconel 718 (of interest in its application to turbine discs, lines, and bellows); and development and evaluation of low-boron alloys. A large portion of materials activity is concerned with: support of design activities in areas of materials selection; surveillance of component fabrication when materials problems are involved; and failure analysis. Materials development continued in the areas of space-environment studies, wear and friction, radiation damage, development of low-boron Inconel 718, and engineering support to other departments. (auth)

28256 (RN-S-0413) PRELIMINARY NERVA THRUST-STRUCTURE DEVELOPMENT PLAN. Jessen, P. J.; Lachnitt, F. G.; Thomas, R. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 29p. Dep. NTIS $4.50.

The primary function of the NERVA thrust structure is to transmit all engine operating loads (both ground and flight), boost loads, and handling and transportation loads from the pressure vessel (PV) and turbopump assemblies (TPA) to the stage structure or facility propellant tankage structure at the interface between the module propellant tank (MPT) and the engine. Additional functions are to provide support for the TPA and the pneumatic supply system and to provide structural interfaces for the thrust-vector system (TVS). A program for the development of a thrust structure starting with the initiation of conceptual design and concluding with completion of design verification is presented. The program consists of three significant areas of accomplishment: (1) design, including analytical effort; (2) development testing; and (3) design-verification testing. Each of these areas has been divided into phases with specific objectives listed to show an orderly and complete program leading to a lightweight, functional, and reliable thrust structure. Guidelines constraining the schedules for the development program, fabrication of test components, and testing are discussed in the introduction. (auth)

28257 (RN-S-0414) PRELIMINARY NERVA PRESSURE VESSEL DEVELOPMENT PLAN. Tracy, D. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 32p. Dep. NTIS $4.75.

A plan for developing the final NERVA engine pressure-vessel design is presented. The development effort will be initiated with conceptual design and component material selection and concluded when the pressure-vessel assembly successfully passes the design verification test. The pressure-vessel assembly will be capable of containing pressurized hydrogen and of providing support for the reactor subassembly. In addition, the pressure vessel will be of flight weight, capable of transmitting acceleration, shock, and vibration loads, and will provide interfaces at the pressure-vessel closure for reactor control, instrumentation, pneumatic supply, and structural-support coolant lines. A remote connection will be required to accommodate remote disassembly and reassembly of the thrust structure. A system will be provided to collect nozzle skirt bypass flow and return it through the pressure vessel into the reflector-inlet plenum. The pressure-vessel assembly will consist basically of a cylinder, closure, fasteners for closure/cylinder attachment and metallic seals at the nozzle/cylinder, closure/cylinder, and any mechanical joints on the pressure-vessel closure ports. (auth)

28258 (RN-S-0415) PRELIMINARY NERVA THRUST STRUCTURE AND THRUST VECTOR SYSTEM DESIGN CRITERIA. Jessen, P. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 12p. Dep. NTIS $4.00.

The design requirements for the thrust structure and thrust vector system (TVS) of the 200,000-lb thrust NERVA engine are defined. The design criteria for these two major engine systems have been combined because preliminary design studies indicate that the thrust structure and structural components of the TVS must be integral to achieve efficient load transfer. The common conditions for which both must be designed are: Static and dynamic loading; space and test stand environments; and system weight. In addition to this ability to function as an integral assembly, each has independent functions and criteria as well. The thrust structure will: perform as a structural base for mounting the turbopump assembly (TPA) and pneumatic supply system components; assemble with the pressure vessel and the module propellant tank (MPT); and provide remote assembly and disassembly capability for the engine from the test stand and with the pressure vessel. The TVS will be capable of aligning thrust vector with the vehicle center of gravity by rotating the engine about a point at a maximum angular velocity. (auth)

28259 (RN-S-0416) PRELIMINARY NERVA PRESSURE VESSEL DESIGN CRITERIA. White, D. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 10p. Dep. NTIS $4.00.

The design requirements for the pressure vessel of the 200,000-lb thrust NERVA engine are defined. The pressure vessel will: Enclose and support the nuclear subsystem; contain the high-pressure hydrogen propellant; provide a return for nozzle-skirt coolant into the aft region of the pressure vessel; provide interfaces for instrumentation, the pneumatic system recharge line, reactor control actuators, and structural support coolant lines; and provide a remote joint at the thrust structure/pressure vessel interface. In addition, the pressure vessel design will provide high reliability, optimum performance, and minimum weight. More detailed specifications are listed. (auth)

28260 (RN-S-0418(Bk. 1)(Suppl. 2)) XE-P TEST PREDICTIONS, SUPPLEMENT 2 TO SECTION 9. Revision to Phase III Run I and Issuance of Phase III Run 4. Book I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1969. 54p. Dep. NTIS $5.75.

In addition to evaluating startup and shutdown techniques, these tests will demonstrate the startup capability of the engine system to an intermediate power level, the capability of the control systems to achieve demanded conditions up to and including rated

power, and the capability of the facility to support engine tests at rated power. Startup limitations, temperature autostarts, pulse cooling, high I_{sp} and high-thrust startup and shutdown, engine restart, and repeatability of performance will also be demonstrated. Transfer-function measurements will also be taken at specified conditions. (auth)

28261 (RN-S-0418(Bk. 1)(Suppl. 3)) XE-P TEST PREDICTIONS, SUPPLEMENT 3 TO SECTION 9. Issuance of Phase III Run 5. Book I. (Aerojet-General Corp., Sacramento, Calif. (USA)). 28 Apr 1969. 28p. Dep. NTIS $4.50.

28262 (RN-S-0418(Bk. 1)(Suppl. 4)) XE-P TEST PREDICTIONS, SUPPLEMENT 4 TO SECTION 9. Issuance of Phase III Run 2, Run 3, Run 8, and Run 9. Book I. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Jun 1969. 40p. Dep. NTIS $5.00.

28263 (RN-S-0418(Bk.1)(Sect.5)) XE-P TEST PREDICTIONS. Section 5 (Steady-State Maps). Book 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1969. 40p. Dep. NTIS $5.00.

28264 (RN-S-0418(Sect. 11)(Bk. 1)(Rev.)) XE-P TEST PREDICTIONS, SECTION 10 (TRANSFER FUNCTION TESTS) REVISION. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Apr 1969. 317p. Dep. NTIS $19.00.

Predictions for various system-response values were made using the XE common analog model. System-response measurements will be made to determine various component and system transfer functions. These transfer functions will in turn provide a basis for evaluating control-system design and for validating computer models for the reactor dynamics. (JWR)

28265 (RN-S-0426) XE CRYOGENIC TEXT PROGRAM. Final Report. Christopherson, H. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 75p. Dep. NTIS $6.75.

The results of the XE cryogenic test program for upper thrust structure components, the upper thrust structure shield segment, and the test stand adapter/upper thrust structure module/shield assembly are given. Objectives, setup, procedures and results are presented. Adequacy of the engine system design to provide operational integrity during XE testing is considered to have been satisfactorily demonstrated. (auth)

28266 (RN-S-0436) PRELIMINARY DESIGN CRITERIA FOR NERVA SKIRT ASSEMBLY. Bronner, H. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 8p. Dep. NTIS $8.00.

28267 (RN-S-0437) PRELIMINARY DESIGN CRITERIA, MAJOR LINE ASSEMBLIES. Davis, L. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 15p. Dep. NTIS $4.00.

Requirements and design criteria are given for six engine lines and line assemblies that provide for the regulated transport of liquid or gaseous hydrogen as required by the NERVA engine. (LTN)

28268 (RN-S-0441) NERVA MATERIALS DEVELOPMENTS FOURTH QUARTER, CONTRACT YEAR 1967 (1 JULY–30 SEPTEMBER). (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1967. 98p. Dep. NTIS $8.00.

Activities pertaining to materials and processes development are described. Topics include materials investigations related to the space environment, wear and friction, radiation damage, and those in support of engine components and of facilities at both AGC, Sacramento, and NRDS, Nevada. (auth)

28269 (RN-S-0444) PRELIMINARY PRESENTATION ON THE INFLUENCE OF SPACE ENVIRONMENT ON NERVA ENGINE DESIGN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1967. 31p. Dep. NTIS $4.75.

Adsorbed gas layers will be removed from surfaces within a few minutes in the space environment. Under such conditions sliding surfaces may be subject to adhesion and sticking. MoS_2 lubricant would be used when a sliding or rolling movement was required. It is expected that the external gimbal systems would be most sensitive to the space environment, but some attention should be given to ball and butterfly valves and to valve actuators. This simulation of this aspect of the space environment on components may be difficult and expensive in view of the extreme high vacuum required. (LTN)

28270 (RN-S-0450) HANDBOOK OF OPERATING AND MAINTENANCE INSTRUCTIONS FOR XE-1 ENGINE CONTROL SYSTEM. Revision 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1968. 114p. Dep. NTIS $8.75.

This handbook provides a current source of operation and maintenance information concerning the XE-1 Engine Control System (ECS). The ECS is discussed in general and the ECS chassis for which AGC and Westinghouse had the design, development, and manufacturing responsibility is discussed in detail. A complete cross reference to all ECS chassis by rack and console number to AGC O&M handbooks is presented. (auth)

28271 (RN-S-0450(Rev.1)(Part 3)) HANDBOOK OF OPERATING AND MAINTENANCE INSTRUCTIONS FOR XE-PRIME ENGINE CONTROL SYSTEM. Revision 1. Part III. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1969. 51p. Dep. NTIS $5.75.

The valve control chassis is located in Rack 49 in the XE-Prime Test Cell Building. The chassis supplies the electrical actuation signals to the five engine valves listed below: turbine power control valve (TPCV), turbine blocking valve (TBV), propellant shutoff valve (PSV), pump discharge vent valve (PDVV), and pump discharge shutoff valve (PDSV). The TPCV is the valve of primary interest because it provides regulation of the propellant flow as demanded by the engine control system. The valve is operated by the TPCV actuator which is mechanically coupled to the TPCV. Electrical actuation signals to position the valve are fed to the TPCV actuator which translates the electrical command into a mechanical position. The generation of this electrical analog command signal (α_D) is accomplished by solid state electronic components within the ECS valve control chassis and the Engine Programmer Controller. An automatic valve position override control is also included in the valve control chassis so that if the measured TPCV position changes at a greater than preset rate the valve control signal is switched to a track and memory circuit. The track and memory circuit holds the valve demand that existed just before the valve started to run away. A switch on the CTE console can inject either a positive or negative signal into the memory circuit giving the CTE manual control after a failure. (auth)

28272 (RN-S-0454) ETS-1 FLUID SYSTEM FMA. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1968. 195p. Dep. NTIS $12.75.

This Failure Mode Analysis (FMA) is submitted as an aid to design and operation in assuring that the ETS-1 test facilities are suitably reliable for static ground-test firing of the X-E engine. The analyses were limited to the following critical fluid systems requiring high reliability during engine test: those associated with the engine test compartment, propellant supply, cooldown, dewar pressurization, vent and relief, engine purge, and external shield fill and drain. FMA items were included when failure modes were determined to be "catastrophic," "critical," or "major." Occasionally, failure modes of less severity were included for continuity or for clarification. The occurrence of two or more interacting failures from independent and unrelated causes was normally considered "incredible," and, as such, was not included. But particular care was taken to differentiate between multiple unrelated failures and related simultaneous, sequential, or cumulative failures. Protection of either one level of component redundancy or a long-proven conservative and accepted design feature was an imposed requirement. Recommendations were based on reliability engineering considerations. Such items as schedule, cost, and ease of accomplishment were not considered since these are not properly a part of an FMA. For each system considered, credible failure modes were delineated together with the cause and effects of that failure. For each failure mode and cause, the "design features and other controls that will minimize failure cause or effect" were defined. Where additional action was indicated to improve reliability, the recommended action was implemented or resolved. These actions are delineated as "Actions Taken or in Progress to Minimize Failure Mode Occurrence or Severity." Immediately following, the action taken or resolution reached is stated; there are no unanswered recommendations. (auth)

28273 (RN-S-0464) NRX-A6 AND NRX PROGRAM DATA ANALYSIS REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1978. 168p. Dep. NTIS $11.50.

Declassified [1974].

The NRX-A6 EP III-A test was run on 15 December 1967. The primary operational objective of EP-III was to accomplish a full-power run for a maximum duration of 60 minutes. This objective was successfully met. A summary of the NRX-A6 test findings is presented along with the results of an investigation of anomalies detected during the test or uncovered in the course of the analysis. The major anomalies studied were in conjunction with the chamber temperature thermocouples that appeared to read low. Primary emphasis has been given to determination and description of best estimates for nozzle-chamber temperature, pressure and flow rates. Topics covered are uncertainty and reproducibility of pressure, flows, and temperatures, engine asymmetries, and nozzle performance including model development and upgrading. (auth)

28274 (RN-S-0469(Rev.5)) E-1 COMMON ANALOG MODEL. Revision 5. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Aug 1970. 62p. Dep. NTIS $6.25.

Revisions to the E-1 common analog model for the NERVA engine are presented. (JWR)

28275 (RN-S-0482) MATERIALS AND PROCESSES PLAN FOR THE NERVA ENGINE SYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1968. 24p. Dep. NTIS $4.25.

This plan describes the objectives of the materials and processes function within the NERVA program in anticipating materials-oriented problems and providing approaches for their prevention. To assure that proper materials are selected and will perform as predicted, all phases of their application and usage are considered, including original concepts, design development, hardware fabrication, and feedback from component test or engine operation. This strong effort in materials engineering and technology, taken early in component design, could not only preclude problems, but also provide verification of materials selection for formal design reviews. (auth)

28276 (RN-S-0486(Vol.1)) XE-1 CAM EQUATION DERIVATION. Volume I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1968. 102p. Dep. NTIS $8.25.

The Common Analog Model is a mathematical model of the XE-1 engine system suitable for analysis with analog computer facilities. The model includes representation of the engine system, controllers, control mechanisms, and test facilities. For the Engine Feed System the first five sections present the individual equations used. Each equation is presented together with six subsections: first – the basic form of the equation; second – the physical equation with proper nomenclature that is used in the simulation; third – the variables in the equation are identified and the units given; fourth – the equation constants are defined in terms of units and value; fifth – the assumptions other than basic assumptions that are peculiar to a specific equation; and sixth – notes that are helpful in determining the origin of the constants and general information about the specific equation. The sixth major section deals with the basic derivation of the general types of equations used in the simulation. For the nuclear subsystem the first section is a basic derivation of equations used, and the second is a detailed presentation of computer equations. (auth)

28277 (RN-S-0491) NERVA MATERIALS DEVELOPMENT FOURTH QUARTER, CONTRACT YEAR 1968 (JULY, AUGUST, AND SEPTEMBER). (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1968. 97p. Dep. NTIS $8.00.

Materials investigations related to wear and friction, radiation damage, space environment, and shield materials and activities in support of turbopump, pressure vessel, nozzle, line, and valve design are reported. Facilities support activities at NRDS are also described. (auth)

28278 (RN-S-0496) XECF FINAL REPORT. Smyth, G. B. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1969. 151p. Dep. NTIS $10.75.

This report covers the activities related to the Experimental Engine Cold Flow (XECF) system from initial assembly to disassembly. It describes the engine system and test facilities and presents a summary of test results and program accomplishments. The Experimental Engine, Cold Flow (XECF) was successfully tested in the Engine Test Stand No. 1 (ETS-1) facility during April 1968. The major objectives of the XECF test series were: (1) to verify bootstrap startup sequences to be used during X-engine testing and evaluate the performance of the assembled engine during startup prior to its use in a nuclear environment; and (2) to check out the complete ETS-1 facility with an engine system to verify that it was ready for nuclear engine testing. The basic objectives of the XECF program were achieved. The tests demonstrated that the engine turbopump could be smoothly bootstrapped with an initially warm pump by monitoring reflector inlet temperature and opening the turbine power control valve at the appropriate temperature representative of proper pump fluid inlet conditions. The tests also demonstrated the satisfactory performance of the various ETS-1 facility systems. In addition, significant operator training and experience were obtained that will be applicable to X-Prime testing. (auth)

28279 (RN-S-0502) NERVA PRESSURE VESSEL MATERIAL PROGRAM PLAN. RN-S-0502. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1969. 26p. Dep. NTIS $4.50.

Selection of the primary NERVA pressure-vessel material requires an extensive, planned program that will provide comprehensive analysis of all factors affecting design, fabrication, and operation. Study of these factors has been incorporated into program phases that include: alloy selection; forge extrusion, and weld-process development; optimum heat-treatment selection; anisotropic and radiation-property evaluation; stress-corrosion evaluation; and design-allowable determination. AA 7039, Inconel 718, and Ti 6A1-4V (ELI) were evaluated as candidate alloys and AA 7039 was selected as the best alloy on the basis of cryogenic fracture-toughness and operational temperature strength coupled with maximum thermal-conductivity properties to obtain minimum gamma radiation heating effects. Fabrication and heat-treating methods are being evaluated with respect to fracture toughness at cryogenic conditions, stress corrosion, and mechanical properties. (auth)

28280 (RN-S-0508) FIBROUS-REINFORCED-GRAPHITE COMPOSITE SKIRT EXTENSION FOR THE NERVA ENGINE. Kotfila, R. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1969. 64p. Dep. NTIS $6.25.

The NERVA flight engine will require a skirt extension from the regeneratively cooled skirt. The gas side temperatures are estimated to be 2600°F at the skirt to skirt extension junction. The material requirements are for structural strength and stability at the 2600°F temperature, thermal shock resistance to withstand multicycle conditions, resistance to attack or embrittlement by the hydrogen exhaust gas, low radiation hazard, and good fabricability for the large sizes. The newly developed fibrous graphite products meet all of the primary material requirements. They are characterized by graphite fiber orientation in the direction desired to provide structural strength and stability and increase in strength from room temperature to the maximum service temperature of 2600°F, and because of the composite fibrous structure, thermal shock resistance is excellent. At 2600°F, attack by H_2 appears tolerable. The density of fibrous graphites is about 1.4 gm/cc and therefore, radiation problems are less than for metallic structure. In addition, there does not appear to be a practical size limitation and the skirt extension size can be fabricated with currently available equipment. (auth)

28281 (RN-S-0510(Vol. 3)(Bk. 1)) XE-PRIME ENGINE, FINAL REPORT. Volume III, Book 1. Test Data Analysis. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 654p. Dep. NTIS $35.75.

The XE-Prime engine was the first nuclear rocket engine to be tested with components in a flight-type, close-coupled arrangement. The general objective was to further extend nuclear rocket technology in preparation for a flight system and to operate the test facility under nuclear firing conditions. This document, Volume III, Book 1 of a three-volume series, provides an analysis of test data. Book 2 presents analytical results oriented toward the engine as a system. Volume I describes the engine and test facilities while Volume II describes assembly, test, and disassembly operations. The XE-Prime test program provided a firm technological basis for development of concepts that may be applied to the NERVA engine, including the use of temperature autostart, engine restart, run-tank topping, and pulse cooling. Many of the techniques developed for efficient operation of the test facility, instrumentation, data acquisition, and rapid data reduction will be useful for future engine development. The basic design concepts of NERVA engine components will be similar to those of XE-Prime. The NERVA engine will be a turbopump-fed engine using hydrogen as the propellant. It will employ a regeneratively-cooled thrust chamber and reflector, and a reactor core and control drums similar to those of XE-Prime. Detailed XE-Prime data will be used to verify or upgrade the basic engineering equations which represent the engine system in the analytical models. (auth)

28282 (RN-S-0511) NERVA MATERIALS DEVELOPMENTS SECOND QUARTER: CONTRACT YEAR 1969 (JANUARY, FEBRUARY, AND MARCH). (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1969. 114p. Dep. NTIS $8.75.

Activities pertaining to materials and processes development included: statistical mechanical properties; physical properties; wear and friction of radiation resistant polymers; effects of high purity hydrogen gas on Ti-5Al-2.5Sn(ELI) and Inconel 718; and contamination control. Activities in support of turbopump, line, nozzle, skirt extension, and valve development are also described. A discussion of NASS duct materials is included. (auth)

28283 (RN-S-0513) TESTING OF TURBINE-POWER-CONTROL-VALVE ACTUATOR. Harris, W. P. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 129p. Dep. NTIS $9.50.

The results of qualification testing of a Model NT-D2 turbine power control valve actuator are presented. Included were acceptance, vibration, life, leak, and stall torque tests. The actuator met or exceeded structural, functional, and vibration requirements. Performance degradation and increased gas consumption noted after 51.94 hr of life testing was attributed to wearing of gear-motor carbon end-plates. The motor was replaced and the test continued for an additional 103 hr. (auth)

28284 (RN-S-0517) REVIEW OF CONTAMINATION TECHNOLOGY. Sweeny, K. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1969. 88p. Dep. NTIS $7.50.

Contaminants and their detrimental effects are defined and emphasis given to the importance of defining the level of cleanliness that NERVA engine components, nuclear subsystems, and related support equipment must achieve. Curves are included to show the effect of particle transport properties and impaction behavior. Procedures are provided for calculation of shear stresses, boundary layer effects and particle adhesion forces. An analysis of quality control techniques is presented. Storage and packaging are discussed. Recommendations are made concerning a contamination control plan. Several types of contaminants that must be dealt with include: (1) material that is reactive with engine surfaces or propellants; (2) gross contaminants such as rags, tubing, metal fragments, which could lead to operational malfunctions; and (3) solvents or liquids that would freeze at liquid hydrogen temperatures. The critical cleaning requirement would probably involve those particle sizes (and concentrations) that would interfere with the operation of the reactor tubes, pneumatic actuators and control drums, turbine parts, bellows, and valves. A number of technical requirements of cleaning processes were analyzed. (auth)

28285 (RN-S-0531) XE-P LOW- AND INTERMEDIATE-POWER PASSIVE DOSIMETRY RESULTS. Hertelendy, N. A.; Courtney, J. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1969. 124p. Dep. NTIS $8.50.

The results of extensive measurements of passive gamma and neutron dosimetry made during EP-1 and EP-1A of the XE-prime engine tests conducted at NRDS are tabulated. Thermoluminescent dosimeters were used to measure gamma kerma, and threshold foils and gold foils were used to measure fast- and thermal-neutron fluences, respectively, at many engine locations. These data were scaled up to full-power (1126-Mw) operation to predict gamma dose rates and neutron fluxes at this level. (auth)

28286 (RN-S-0543) NERVA MATERIALS DEVELOPMENTS FIRST QUARTER: CONTRACT YEAR 1970 (OCTOBER, NOVEMBER, AND DECEMBER). (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1970. 146p. Dep. NTIS $10.50.

Material and processes development activities included the detrimental effects of high pressure, pure gaseous hydrogen on the mechanical properties of Waspaloy and Alloy 718, and the development of statistical design allowables for ring forged and extruded AA7039-T63, triple-braze 347 stainless steel nozzle forging, and Ti-5Al-2.5Sn(ELI) forging materials. Friction and wear characteristics of polyphenyl ether lubricated polyimide "SP-1" Vespel material for valve applications and fibrous graphite skirt extension design and fabrication are also described. Welded Alloy 718 sheet for turbopump application, stress corrosion evaluation of AA7039-T63 for pressure vessel applications, and Aluminum Alloy sheet weld development for lines are also included. (auth)

28287 (RN-S-0552) DESIGN IV (0.37g) SPECTRUM SEISMIC-RESPONSE ANALYSIS OF ENGINE TEST STAND No. 1. Tow, D.; Severud, O. G.; O'Callaghan, T.; Reid, R. T. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Mar 1970. 57p. Dep. NTIS $6.00.

A detailed seismic-response analysis of ETS-1 has been completed to establish a valid structural dynamic model for the test stand and to predict strengthened test-stand dynamics under the influence of future nuclear events. The structural dynamic model of ETS-1 as developed in Report RN-S-0542 was modified. The calculated fundamental test-stand frequency shows a mean value of 2.37 Hz for motion perpendicular to the shield wall. In addition, results of the model analysis show that ETS-1 exhibits many other theoretical resonant frequencies. There are 34 such frequencies below 50 Hz, of which 17 are below 20 Hz. For the 0.37g event considered, maximum absolute accelerations at the top of the test stand were calculated as 1.20 and 1.22g, for column lines (1) and (2) of ETS-1 respectively. In addition, 24 time-history responses, in the form of accelerations, velocities, and displacements on the test stand were calculated. The maximum seismic magnification factor for the Design IV event is estimated to be about 6. As a check on the consistency of interpretation of the time history of ground acceleration, a computer program was developed to provide the responses of simple single-degree-of-freedom systems to such an input. The response spectra generated shows good agreement with an independent evaluation in that both closely reproduce the magnitude of the principal peak of the 2 and 5% Design IV PSRV spectra. (auth)

28288 (RN-TD-0002(Rev.C)) ACCEPTANCE PROCEDURE XE-1 ALUMINUM PRESSURE VESSEL. Revision C. Cornell, A. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 May 1966. 17p. Dep. NTIS $4.00.

Acceptance involves conformance to dimensional specifications as made and under pressure; hydrostatic testing (including cycling) at 740 psig, and leak tightness. (LTN)

28289 (RN-TD-0002(Rev.D)) ACCEPTANCE PROCEDURE XE-1 ALUMINUM PRESSURE VESSEL. Revision D. Cornell, A. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). 3 Aug 1966. 17p. Dep. NTIS $4.00.

Acceptance involves (1) conformance to dimensional specifications as made and under pressure, (2) hydrostatic testing (including cycling) at 740 psig, and (3) leak tightness. (LTN)

28290 (RN-TD-0050) FIVE-INCH BUTTERFLY VALVE (PDVV) RANDOM VIBRATION TEST. Final Report. Lundback, A. V. (Aerojet-General Corp., Sacramento, Calif. (USA)). 4 Mar 1969. 62p. Dep. NTIS $6.25.

The basic test objectives were accomplished. The PDVV withstood the vibration environment imposed by all phases of the vibration test program and no detrimental structural failures were noted which were directly attributed to the vibration environment. The functional tests following the vibration tests were satisfactorily performed and no anomalies with respect to cycle times and position traces were observed. Based on the test results and conclusions, the PDVV is considered acceptable for use during 70 minutes of XE-engine operation with no anticipated problems. (auth)

28291 (RN-TM-0005) PHOEBUS-2 TEST STAND H-4B DYNAMIC ANALYSIS. Tow, D. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1966. 62p. Dep. NTIS $6.25.

Test Stand H-4B, located at the Aerojet Test Area Zone H, is primarily designed to test, in a horizontal position, the Phoebus-2 Nozzle (AGC Hastelloy X Convective Cool Nozzle) with a thrust of 240,000 pounds. However, the stand is structurally capable of withstanding a maximum steady state thrust of 330,000 pounds. The induced dynamic environments and the cyclic gimbaling of this nozzle will undoubtedly impart large dynamic loads into the test stand. It was feared that the dynamic environment induced from the nozzle operation might amplify these static deflections, and thus cause structural failures in the lines as well as in the test stand structure. Experience from past rocket engine operations has shown that, in many cases, both the static and dynamic environment were present simultaneously and produced a greater degree of severity to the test structure. A structural dynamic analysis was performed on the Phoebus-2 Test Stand H-4B. Using computer techniques, the natural frequencies of the stand for the first three modes are 12.3 Hz (or cps), 20.7 Hz, 27.0 Hz, respectively. Dynamic deflections at the nozzle tip, due to full scale nozzle operation, are computed to be 0.173-in. in the vertical upward direction and 0.082-in. in the horizontal forward direction. These deflections are primarily due to the nozzle thrust (thrust misalignment and flow separation side loads account for less than 5% and therefore can be neglected). The dynamic environment is not capable of causing any structural failure in the Phoebus-2 test stand and nozzle assembly. (auth)

28292 (RN-TM-0125) EVALUATION OF NRX-A NOZZLE, S/N 009, COOLING ADEQUACY. Shurley, L. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 21 Jul 1964. 6p. Dep. NTIS $4.00.

In order to determine whether the NRX nozzle would stand up to the thermal loads of a full power reactor test, a nozzle was subjected to a combustion test estimated to be 150°F overstimulation as compared to full reactor power. While incipient failure of a few coolant tubes was experienced at these more severe conditions, it is concluded that the redesigned nozzle is adequate for full power reactor testing. (LTN)

28293 (RN-TM-0130) NERVA INJECTOR DEVELOPMENT HISTORY. Heinicke, D. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 27 Oct 1964. 68p. Dep. NTIS $6.50.

NERVA reactor operating conditions are to be simulated in a series of liquid oxygen/liquid hydrogen chemical firing tests to evaluate candidate NERVA nozzles. The history of all injector patterns evaluated for these nozzle tests is reviewed. The problems associated with each pattern are discussed and the reasons for each new pattern design tested are presented. (HDR)

28294 (RN-TM-0187) SIMULATED GUIDE TUBE-PRESSURE VESSEL CLOSURE JOINT TEST EVALUATION REPORT. Locke, J. N. (Aerojet-General Corp., Sacramento, Calif. (USA)). 22 Apr 1965. 19p. Dep. NTIS $4.00.

Sealing difficulties have been experienced at the pressure vessel closure to guide tube joints during numerous test assemblies, including NRX-A1, NRX-A2, CFDTS, and NRX-A3. Since lack of sealing is a potential fire hazard to engine systems or reactor testing an effort has been made to solve the sealing difficulty. A new design based on the Marman clamp-Conoseal type joint was chosen over the existing configuration requiring use of an "AN boss type K seal". The new configuration chosen utilizes axial movement exclusively to close the joint, thus not disturbing the initial seal. Excellent performance of the proposed joint

configuration for the pressure vessel closure to guide tube joint has been shown by proof testing to 1500 psig and leak testing with hydrogen and helium to 1000 psig at −320°F as well as at ambient temperature. The proposed joint configuration was tested successfully to conditions considered more severe than operating conditions. Test results indicate clearly that the proposed joint configuration is not sensitive to thermal cycling unless the coupling is not properly tightened. Based on the testing described, it is recommended that the proposed Marman clamp-Conoseal type joint be adopted for future guide tube-pressure vessel closure interface design. T-4 aluminum alloy seals should be utilized in the proposed joint. Coupling tightness is an important requirement to achieve good sealing. Care must be employed when assembling this proposed joint configuration to achieve uniform clamping of the V-band coupling. (auth)

28295 (RN-TM-0206) PERFORMANCE LIMITATIONS OF XE-ENGINE. Burden, J. R. Jr.; Ramsthaler, J. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Mar 1965. 42p. Dep. NTIS $5.25.

A study has been completed to determine components limiting the power of the NERVA I engine. An XE-engine model was constructed using known components intended for the XE-engine and late design NRX/EST hardware data where necessary to complete this model. The engine was assumed to operate at 1.25 psia ambient pressure with a 40 psia propellant tank pressure. A basic design point of 1500 megawatts power at 4300°R chamber temperature and 1500°R turbine inlet temperature was set as the initial operating point. To meet this design point, it was assumed that the hot bleed port could deliver the required diluent flow. A series of steady-state cycle balances were made by independently varying chamber pressure and temperature until component constraints were found which limited operation. No attempt was made to investigate any transient instabilities which could further restrain engine operation. The maximum power output of the NERVA I engine was found to be limited by the maximum wall temperature of the nozzle tube, 1780°F, and six other constraints which would be effective at power levels of 1270 to 1480 MW. Also at these power levels the maximum allowable reactor temperature, 4500°R, was approached. (auth)

28296 (RN-TM-0308) RADIOMETRIC MEASUREMENT OF NOZZLE COOLANT TUBE TEMPERATURE. Geery, E. L.; Thompson, W. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 24 Jan 1966. 11p. Dep. NTIS $4.00.

A need for a direct measurement of the wall temperature in the NERVA U-tube nozzle resulted in the design and testing of a multicolor radiometer. A breadboard model of an infrared device was evaluated and 4 prototype models were fabricated, calibrated and monitored during the chemical simulation testing of the S/N-021 nozzle last July and August. The results of these tests were inconclusive in that no temperature measurements were made, and only minimal evidence of system performance was noted. A mode-of-failure analysis and review of the chemical simulation test data indicated that the radiometers as designed may be restricted to reading wall temperatures in excess of 800°F. An 800°F temperature limit means applicability is limited in any current nozzle test program to specific locations. It is proposed that ways of increasing the operational range be evaluated analytically and that a laboratory study be conducted to increase the signal strength at low wall temperatures, thus increasing the utility of the instrument. (auth)

28297 (RN-TM-0337) STRUCTURAL ANALYSIS OF THE SEAL RING IN THE NERVA TURBINE. Lefevre, J. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 28p. Dep. NTIS $4.50.

A stress analysis of the seal ring in the NERVA turbine discloses some yield in some areas even at nominal operating conditions. The yield zone is larger at overspeed and skill greater at overspeed trip (051), but the strain reaches only 4.5 percent of the ultimate. The yielding is effected by rotation and temperature. With A-286AMS 5735 material, the burst speed is 40,600 RPM, so there is a reasonable margin of safety even at overspeed and overspeed trip. (LTN)

28298 (RN-TM-0361) ASSEMBLY PROCEDURE FOR THE EXPERIMENTAL ENGINE-COLD FLOW AT AGC-SACRAMENTO. Sandberg, H. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Jul 1966. 37p. Dep. NTIS $5.00.

28299 (RN-TM-0367) STRESS ANALYSIS OF THE XE EXTERNAL RADIATION SHIELD. Lucier, J. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1966. 17p. Dep. NTIS $4.00.

The XE-1 External Shield, while not an actual part of the engine system, was designed as an integral part of the Engine Structural Assembly. Its primary purpose is to capture or reflect radiation emanating from the reactor during testing and cooldown. When the engine assembly is installed in the ETS-1 test cell, the shield becomes a part of the enclosure which surrounds the pressure vessel and reactor assembly. The shield is basically a very strong structure capable of reacting to loads much greater than those to be imposed on it. The analysis, therefore, consists of an investigation of the primary members which lie along the load path rather than a rigorous, comprehensive analysis as would be expected for a more delicate structure. These parts are identified and the margins of safety determined when they are exposed to the estimated loading. (auth)

28300 (RN-TM-0375) RESULTS OF DISASSEMBLY AND INSPECTION NRX/EST TURBOPUMP P/N 708800-69, S/N 015. Andrews, F. X.; Nishioka, T. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1967. 19p. Dep. NTIS $4.00.

Following the NRX/EST test series, the turbopump was removed from the test car and disassembled. The results of the post-operative disassembly and examination are reported. No abnormal conditions were found. (auth)

28301 (RN-TM-0384) X-ENGINE TSA/UTS REMOTE INTERFACE DEVELOPMENT MECHANICAL COMPONENTS TESTING. Final Report. Specht, J. J.; Bermingham, A. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 21 Sep 1966. 36p. Dep. NTIS $5.00.

A test program was conducted to evaluate the capability of remotely connecting and disconnecting the individual components of the interface between the Upper Thrust Structure (UTS) of the Experimental Engine (XE), and the Test Stand Adapter (TSA). The units tested included a pneumatic line connector, structural connector, fluid line Marman coupling, and the remote actuation systems used to operate the latter two components. The testing was done in conformance with Test Plan Number 7443-02 "Partial Test Stand Adapter, Upper Thrust Structure, Remote Connect/Disconnect Test Assembly." These components were first individually proof-tested and checked for function, and then mounted on simulator test plates. The simulator consisted of a ¾ inch thick simulated TSA interface plate and a ¼ inch thick simulated UTS plate. These interface test plates were mounted in a hydraulic press to provide a means of performing controlled mating cycles. The simulator was instrumented, and continuous chart recordings made of loads, cycle times, and pressures. More than 200 mating cycles were completed and all components functioned successfully. All program objectives were fulfilled and information developed has contributed significantly to the finalized XE design. (auth)

28302 (RN-TM-0394) PREDICTED SIZE AND GEOMETRY FOR THE NES EFFLUENT PLUME FOR NOMINAL REACTOR AND DESIGN DEMONSTRATION TESTS AT ETS-1. Thompson, W. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 5 Oct 1966. 10p. Dep. NTIS $4.00.

As part of a re-analysis of the safety aspects of test stand operation, estimates of plume size have been recomputed using current Steam Generator System data and hydrogen flow rates within the capabilities of the stand. For no-wind daylight testing of the system, the full-power reactor case has a predicted flame length of 169 ft and 296 ft for the design demonstration test. A comparison of the anticipated geometries is shown. (auth)

28303 (RN-TM-0397) PREDICTED NUCLEAR EXHAUST SYSTEM (NES) PERFORMANCE. DaVolio, J. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Oct 1966. 25p. Dep. NTIS $4.25.

During the Nuclear Exhaust System (NES) Design Demonstration Tests, the duct, steam generator, and engine compartment will be cold-flow-tested as a system for the first time. These tests are intended to demonstrate safe and satisfactory system operation before the NES is used during nuclear-engine testing. Prior to design and fabrication of the NES duct, a subscale-model testing program was conducted to predict the operational performance of the full-scale duct. Results of the subscale-model program appear in REON Report RN-S-0099 (Revised), October, 1964, applicable sections of which are included herein to provide predictions for the full-scale tests. (auth)

28304 (RN-TM-0408) TEST RESULTS NERVA-NOZZLE HOT-BLEED-PORT SEAL EVALUATION. Coppo, R. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1967. 24p. Dep. NTIS $4.25.

The results obtained in a test program to evaluate seal performance at the interface between the hot-bleed port and the nozzle are presented. The program was necessitated by marginal performance of the previously used E-seal. Helium leakage of Nozzle SN 027 had revealed leakage at a pressure of 100 psig during preparation for chemical-simulation testing at Sacramento. Four different metallic seals were tested in accordance

with Test Plan RN-TP-0006 and modifications thereto. Of the four, only one (the Aeromega seal) repeatedly met the acceptance requirements limiting maximum leakage to 10^{-2} std cc/sec per inch of seal diameter. The sealing capabilities of the other three seals (O-Val, E-seal, and K-Seal) require improvement to meet the maximum allowed leakage rate. (auth)

28305 (RN-TM-0410) EVALUATION OF NRX-A5 PRESSURE VESSEL. Tracy, D. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1967. 21p. Dep. NTIS $4.25.

The NRX-A5 pressure-vessel assembly successfully demonstrated its ability to withstand all pressure and environmental loading and to function satisfactorily during an extended-duration nuclear test. No abnormalities in performance were detected. (auth)

28306 (RN-TM-0428) NERVA PRESSURE VESSEL PRELIMINARY WEIGHT STUDIES. Tracy, D. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 Apr 1967. 22p. Dep. NTIS $4.25.

Based upon current schedules it is important that a decision be made on the material to be used for the NERVA pressure vessel. Titanium 6 Al-4V shows a weight and a strength to weight ratio advantage over 7039-T61 aluminum. This weight advantage would not be possible to achieve because of undesirably low temperature toughness and ductility properties of the titanium material. In addition, the lack of radiation effects data and uncertainties in fabrication control contribute to the uncertainty which eliminates the material as a candidate at this time. The weight comparison between 7039-T61 aluminum vessel is significantly lighter. Major differences occur in flange areas and closure ports where geometric considerations for bolting and access ports do not make it possible to take advantage of the high strength material. A small difference in areas where membrane stress is the prime design consideration occurs because at operating temperatures the strength to weight ratio is higher for 7039-T61 aluminum. It is recognized that further optimization could reduce the weight differences between 7039-T61 aluminum and Inconel 718. However, it is apparent that the weight advantage of the aluminum material will remain unless new design criteria become known in the future. Every attempt has been made to evaluate all factors which would influence the pressure vessel weight. Therefore, it is recommended that on a weight basis, with all other considerations such as cost, ease of fabrication, and material availability set aside, the 7039 aluminum alloy be selected as the NERVA pressure vessel material. (auth)

28307 (RN-TM-0436) NERVA THRUST VECTOR SYSTEM LOCATION STUDY. Thomas, R. W.; Lutton, L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 30 Jun 1967. 29p. Dep. NTIS $4.50.

A comparative study was made to determine the better of two locations for the gimbal plane of the NERVA Thrust Vector System. Locations considered were between the engine to stage interface and the turbopump and between the turbopump and the pressure vessel. Considering the four equally spaced ball screw mechanism and the gimbal ring concepts as representative gimbaling methods, the significant factors of location on the gimbaling system and other engine components are discussed. It was concluded that the location forward of the turbopump was the better of the two due to fewer components being affected resulting in greater simplicity in the design and development of the engine. Further, the gimbal center location has been selected to coincide with the turbopump inlet bellows. (auth)

28308 (RN-TM-0439) NERVA PRESSURE VESSEL DESIGN REPORT. Cornell, A. D.; Jellison, J. E.; Tracy, D. W.; Vick, O. D.; Wilcox, A. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1967. 53p. Dep. NTIS $5.75.

The design, nuclear analysis, and thermodynamics analysis provided data for a detailed structural analysis of an aluminum 7039 pressure vessel. The stress analysis, based on current 200,000 lb thrust engine conditions with the added conservatism of an unshielded 4200 MW reactor subassembly, indicated positive margins of safety for all components of the aluminum pressure vessel. Combining the design, weight study and analytical results with cost, fabrication and materials engineering considerations, aluminum is the most advantageous candidate vessel material. Therefore, it is recommended that aluminum 7039 be selected as the NERVA pressure vessel material. (auth)

28309 (RN-TM-0440) HYBRID SPECTRAL-ANALYSIS SYSTEM. Benenson, H.; Corey, I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1967. 111p. Dep. NTIS $8.75.

The methods of analysis and processing that will be performed on XE-engine wide-band data to obtain power-spectral-density plots and listings are summarized. The system is an analog-digital hybrid system that accepts data directly from 14-channel or 32-channel NTO analog tapes. This system is tied into an IBM 360 Model 40 computer, which completely processes the data and plots or lists the results (or both) in a standard form for a specified level of precision and accuracy. The procedures for processing and the quality-control methods that are applied are also defined in some detail because Aerojet experience in power-spectral-density analyses has shown that control of each step in processing and analysis is essential to ensure valid data. The accuracy that might be expected is described for random and deterministic types of data so that an index of the confidence that can be expected will be known. The hybrid spectral-analysis system has been developed so that valid data can be obtained quickly and economically. The hybrid system is a completely self-contained integrated system and, as such, will not interfere with other analyses and procedures being performed for wide-band data analyses except for the use of the computer and plotting equipment. (auth)

28310 (RN-TM-0449) NERVA PROPELLANT-SHUTOFF-VALVE (PSOV) DESIGN REPORT FOR 200,000-LB THRUST ENGINE. Anton, D.; Lundback, A. V.; Schwartz, M.; Smith, V. A.; Toboni, J.; Williams, S. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1967. 89p. Dep. NTIS $7.50.

Analyses leading to the current design of the NERVA propellant shutoff valve (PSOV) are presented. Derivation of the requirements, valve type, and design details are discussed, including structural, thermal, fluid-dynamic, material, and instrumentation. The valve design presented will provide a highly reliable unit having all the performance capabilities required. (auth)

28311 (RN-TM-0550) POSTTEST RESULTS OF NRX-A5 EVALUATION ACCELEROMETERS ELECTRA SCIENTIFIC CORP. MODEL NO. AXB-6070. Harper, H. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 9 Oct 1967. 15p. Dep. NTIS $4.00.

Five Electra Scientific Corporation Model AXB-6070 accelerometers were mounted on the forward flange of the NRX-A5 pressure vessel for evaluation purposes. The general purposes of the test were to determine whether this transducer element design should become a candidate for development for use on the NERVA Program and whether it could be used on subsequent technology engine tests to gather qualitative data in the combined engine environments. Post-irradiation tests indicated that no permanent damage to the sensing element resulted from exposure to the combined environments at the forward flange of the NRX-A5 vehicle throughout the entire test series. Data provided by these transducers were comparable to the strain gage accelerometer and are valid qualitative representations of the acceleration levels experienced during the test. However, since the physical stimulus was not controlled, it is not possible to determine the accuracy of the data. It is concluded that this accelerometer design is a promising candidate for development for use on NERVA engines. It is recommended that further testing be performed to: determine the accuracy of the transducer during irradiation, determine dose rate effects on the transducer, and extend total radiation exposure to levels commensurate with those anticipated for NERVA. (auth)

28312 (RN-TM-0560) DEVELOPMENT OF A TURBINE POWER-CONTROL VALVE FOR NERVA. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Apr 1968. 13p. Dep. NTIS $4.00.

The original NERVA design concept required a valve to control the flow of turbine drive fluid to the propellant pumping system. The design had to provide for positive fluid power shutoff to the pump turbine for engine shutdown, minimum pressure loss for bootstrap startup of the engine, and infinite flow-control adjustment between the fully open and fully closed operating limits. Selection of nuclear-radiation-resistant materials was also of prime importance to provide adequate strength over a wide range of temperature and pressure operating conditions in a hydrogen environment. Prospective materials for major components were narrowed to Inconel X-750 and Inconel 718. A 4-in.-dia butterfly-type rotary-actuated valve was selected that featured a 20-deg canted shaft to support the butterfly disk. This design provided total circumferential sealing between the valve-body bore and the butterfly disk in the closed position, low pressure loss in the open position, and desirable flow-control characteristics in the intermediate positions. Development testing of the valve has demonstrated its capability to control hydrogen flow at temperatures from 40 to 1800°R and inlet pressures up to 650 psi. A valve of the type discussed herein has been used successfully to control pump turbine power for the NERVA breadboard engine tests (NRX/EST) and will likewise be used on the NERVA experimental-engine program. (auth)

28313 (RN-TM-0575) ETS-1 ACOUSTIC MODIFICATION EVALUATION OF DAMPING COEFFICIENT AND VIBRATION-TEST RESULTS. Hall, I. K. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1969. 39p. Dep. NTIS $5.00.

The original ETS-1 duct-vault inerting wall was found to have rips and tears in the sheet metal after XE cold flow tests. Investigation showed the wall to be inadequate to sustain the anticipated acoustic and blast environment during full-power operating conditions. Therefore, a redesign of the wall was required. The conditions under which the wall must operate were established as follows: Oscillatory Combustion—discrete sinusoidal excitation between 10 and 20 cps at 162 db maximum sound pressure level; blast—local hydrogen detonation which would cause a pressure loading (1.95 psi maximum); and jet noise—exhaust plume random acoustic excitation as shown in Figure 3 (154 db maximum overall sound pressure level). The design details and preliminary stress calculations were performed using the assumption that: the fundamental resonant frequency of the individual panels, as well as the whole wall, would be above 28 cps so there would be no amplification to the oscillatory combustion excitation; and the individual panel amplification ratio ("Q") would be 6 or less. To verify panel characteristics, a representative section of the wall was tested. The tests defined an amplification ratio ("Q") of 12 for the bare panel at ambient temperature. When the panel was sprayed with commercial damping material (Lord Manufacturing Co. LDS-502), the amplification ratio was lowered to less than 3 over a temperature range from 118 to 150°F and to less than 6 for the entire test temperature range of 70 to 200°F. The above results verify that the panel has a resonant frequency greater than 28 cps and that the amplification factor is less than 6 over the anticipated operating temperature range. Therefore, the design requirements have been more than adequately met. An endurance test was also conducted. It was terminated after 40 minutes because of potential health hazards to personnel from the intense acoustic field generated by the vibrating panel. No damage to the panel was observed. (auth)

28314 (RN-TM-0578) TURBINE BLOCK VALVE FLEX LINE VIBRATION TESTING. Shrade, F. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1969. 39p. Dep. NTIS $5.00.

The results of the first test series showed the 12-in. long flex line was sensitive to vibration. The first test specimen failed within the first ten minutes of vibration testing. The second test specimen failed after 130 minutes of vibration testing. The 24-in. flex line and the rigid stainless steel line survived 210 minutes of vibration at the same levels without any apparent damage. A rigid aluminum line failed during the first ten minutes of testing due to a cracked flare. Another aluminum line was substituted and survived for the remainder of the test: i.e., 200 minutes. The results of the second test series, using the new two-ply 28-in. long flex line, showed the new line was capable of withstanding tests that caused the 12-in. long single-ply flex line to fail. The same rigid lines that were used in the first test series were used in the second test series. A new 24-in. single-ply flex line was used for the second test. The rigid lines survived the second test series, but the new single-ply 24-in. flex line failed during the last 30 minutes of the final two-hour test. (auth)

28315 (RN-TM-0579) ACOUSTICAL STUDY OF THE NOISE FIELD OF THE JET FROM THE ETS-1 SCALE-MODEL NES DUCT. Fairall, R. S. (Aerojet-General Corp., Sacramento, Calif. (USA)). 14 Jan 1969. 68p. Dep. NTIS $6.50.

Evaluation of the XECF test data and inspection of the ETS-1 facility following these tests, which were conducted with a duct effluent of relatively low energy content, indicated that the jet noise expected in later XE tests would be more than annoying, reaching destructive levels. In order to eliminate damage to susceptible portions of the facility, a three-step program was implemented: analytic predictions of the acoustic environment for major power holds, clarification of factors employed in defining the high power (XE simulation) jet noise field by means of scale model tests, and improvement of facility components as required to withstand this environment. The second step, the scale model program, is described. A 1/8-scale model of the NES duct was employed, using hydrogen, nitrogen, and helium as the primary (engine) fluids, and nitrogen as the secondary (ejector) fluid. Six external sound pressure measuring microphones were used in the study; two in the near field, four in the far field. Mixtures of hydrogen, helium and nitrogen at various velocities and temperatures were expelled from a duct which terminated in a 45 degree elbow to impart an upward thrust to the gas jet, about 40 degrees with the horizontal. Twenty separate tests were conducted resulting in about 500 sound pressure measurements. Tests were conducted both during the day and at night; night tests were made when photographs of hydrogen combustion were needed. Microphones were interchanged and one test was repeated to verify that results were reproducible. All acoustic data were processed for spectral evaluation. The burning hydrogen jets showed a "bi-modal" noise spectrum which was unique. There is a low frequency contribution which appears to result from the combustion process. The data from the non-burning hydrogen, nitrogen, and helium jets show typical jet noise, similar to that reported in the literature in the field of acoustics. Jet conversion efficiency, limits of combustion, and frequency spectra results are reported. Oscillatory combustion was considered possible but no evidence of its occurrence was obtained. (auth)

28316 (RN-TM-0587) TPCV ACTUATOR GEAR MOTOR DISCREPANCY EVALUATION AS RELATED TO ENDURANCE LIFE. Zwettler, R. F. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 4p. Dep. NTIS $4.00.

Based on correlations of measured useful life and measured gear/pinion misalignment, it is reasonable to assume that the misalignment was a major factor contributing to premature gear motor failure. Procedure RN-TP-0113 correcting this misalignment has been issued, and the existing gear motor matched body assemblies are being repaired without violation of any of the other matched assembly characteristics. (auth)

28317 (RN-TP-0014) ACCEPTANCE PROCEDURE: NOZZLE, U-TUBE, NERVA. NRX-A6. Bronner, H. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 29 Aug 1966. 11p. Dep. NTIS $4.00.

Procedures which will be used to determine that a candidate nozzle is acceptable for use on the NRX-A6 assembly are outlined. Static proof, leak, water flow, and tube cross-sectional area measurement tests will be performed to demonstrate the nozzle has been correctly fabricated, and to provide assurance that it will be capable of withstanding, without damage, the pressure loads imposed during the NRX-A6 test program. Radiographic and leak tests are also described. (auth)

28318 (RN-TP-0100) FLEXONICS METAL HOSE ASSEMBLY RANDOM VIBRATION TEST PLAN. Sutter, W. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Dec 1968. 13p. Dep. NTIS $4.00.

As a result of a failure of a 3/8" by 12" Flexonics metal hose during random noise vibration testing of the XE Turbine Block Valve, a program is proposed to determine the vibration limits of such hose assemblies, including the effects of internal pressure and hose length. (LTN)

28319 (RN-TP-0056) NRO TEST PLAN FOR EVALUATION OF NOZZLE COOLANT CHANNEL END CAPS. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jun 1968. 16p. Dep. NTIS $4.00.

An experiment was devised to determine the extent to which pressure drop in NERVA nozzle tubes can be reduced without sacrificing cooling effectiveness. The test facility and methods are described. (JWR)

28320 (RP-DR-002) TEST SPECIFICATION: PHOEBUS-2 NOZZLE, NUCLEAR SIMULATION. Kawashige, C. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). 11 Feb 1966. 44p. Dep. NTIS $5.25.

Preparatory procedures and conduct procedures for the nuclear simulation testing of the Phoebus-2 nozzles are presented. (JWR)

28321 (RP-DR-0003) PHOEBUS-2 SIX MONTHS MATERIALS DEVELOPMENT REPORT FOR 15 AUGUST 1965–15 FEBRUARY 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1966. 161p. Dep. NTIS $11.25.

Although the primary effort was expended on the Phoebus-2 nozzle development phases, participation in design reviews and materials selections was also provided. In addition, technical engineering data and support were provided to the design activity on nozzle jacket component procurement and related hardware such as injector and adapter assemblies. The material presented is divided into five sections: properties program, welding development, brazing development, heat transfer tubes—thermal cycling tests, and material procurement and nozzle procurement support. The Phoebus Materials Development Program consists of Hastelloy X investigations only, and is mainly involved with determining design mechanical properties of forgings. (auth)

28322 (RP-DR-0002(Rev.1)) PHOEBUS-2 NOZZLE, NUCLEAR SIMULATION. Revision I. Test Specification. Kawashige, C. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Jan 1967. 44p. Dep. NTIS $5.25.

Revised preparatory procedures and conduct procedures for nuclear simulation testing of the Phoebus-2 nozzles are presented. (JWR)

28323 (RP-MR-0012) PHOEBUS-2 MONTHLY PROGRESS REPORT FOR THE PERIOD OF 1 JULY–31 JULY 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1966. 15p. Dep. NTIS $4.00.

Progress in design, fabrication (welding), procurement, testing and reports issued is reported. Correlations of nozzle cooling have been made in six distinct operating regimes. Various stress analyses have been made. (LTN)

28324 (RP-MR-0015) PHOEBUS-2 MONTHLY PROGRESS REPORT FOR THE PERIOD OF 1 DECEMBER–31 DECEMBER 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1967. 201p. Dep. NTIS $13.25.

Work on nozzles and other reactor components is reported, mainly dealing with welding and brazing developments in connection with fabrication. Some mechanical testing results are reported. Also, mechanical properties of Hastelloy X at room temperature and at –320°F are reported, including some fatigue results and exposure to large thermal stresses. (LTN)

28325 (RP-MR-0016) PHOEBUS-2 MONTHLY PROGRESS REPORT FOR THE PERIOD 1 JANUARY–31 JANUARY 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1967. 30p. Dep. NTIS $4.50.

Work was mainly concerned with nozzle fabrication (including nozzle cooling systems) and involved brazing and welding development and testing. Some mechanical properties of Hastelloy X at room temperature and at –320°F are given. (LTN)

28326 (RP-MR-0018) PHOEBUS-2 MONTHLY PROGRESS REPORT FOR THE PERIOD 1 APRIL–30 APRIL 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 210p. Dep. NTIS $13.50.

A re-evaluation of the convectively cooled nozzle modes-of-failure program was made. Additional fail-safe shutdown modes were determined to be necessary and will be installed for future tests of the convectively cooled nozzle. The analog computer program was modified to include the additional fail-safe shutdown modes. A series of analog computer simulation runs were accomplished: (1) to investigate start-transient revisions necessary to accommodate a higher flow-rate in the nozzle prechill system; (2) to consider conditions existing during a variety of malfunction modes in the start-transient, steady-state, and shutdown portions of typical convectively cooled nozzle tests; and (3) to consider conditions created by the malfunction of test-facility systems. Preparation of the test stand and control room for film-cooled nozzle testing was initiated. Separation of the instrumentation functions to isolate the data systems from the control systems was commenced. Design information concerning the Phoebus coaxial injector is provided. Design criteria are presented. Supporting documentation is provided in the areas of coolant flow, and structural analysis. A basic parts list is included. (auth)

28327 (RP-P-0001) PHOEBUS-2 NOZZLE PROGRAM PLANNING REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1965. 81p. Dep. NTIS $7.25.

The objective is to perform a design evaluation of a nozzle concept, to obtain engineering calculations, preliminary design layouts, and a model specification. A selection of fabrication and inspection methods for the nozzle shall be made and fabrication and installation of special test equipment for nozzle testing shall be completed. The concept, including the nozzle contour in both the convergent and divergent sections, shall be selected with consideration to heat transfer, fabrication, repair, inspection and testing of the nozzles and be justified on the basis of: stress analysis, heat transfer and fluid analysis—tube and structure, interface and interactions, testing problems, fabrication methods, inspection and/or special quality control problems, failure mode analysis, repairability, provision for instrumentation, new technology required, growth capability in reactor discharge gas temperature, and schedule. (auth)

28328 (RP-QR-0005) PHOEBUS-2 QUARTERLY REPORT FOR THE PERIOD OF 1 JUNE 1966–31 AUGUST 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1966. 35p. Dep. NTIS $4.75.

Progress in design, fabrication (brazing, welding, etc.) and testing (heat transfer) is reported. A 2 MeV x-ray unit is being installed for inspection to aid in reliability and quality assurance programs. (LTN)

28329 (RP-QR-0006) PHOEBUS-2 QUARTERLY REPORT FOR THE PERIOD OF 1 SEPTEMBER 1966–30 NOVEMBER 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1966. 43p. Dep. NTIS $5.25.

Particular emphasis is given to the brazing of Nozzle S/N 880600, to a materials test program which sought to improve the quality of nickel plating applied to nozzle components, and to the evaluation of stress concentration and thermal-stress conditions in the Hastelloy X nozzle jacket. Other test equipment installations, test facility improvements, test results, and nozzle fabrication progress are mentioned. (auth)

28330 (RP-QR-0007) PHOEBUS-2 QUARTERLY REPORT FOR THE PERIOD OF 1 DECEMBER 1966–28 FEBRUARY 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1967. 34p. Dep. NTIS $4.75.

Activation of Test Stand H-4B was initiated. Verification of the test stand control system was made through use of the Comcor CI 150 simulation unit. After installation of the nozzle test assembly in the test stand, flow tests of the fuel, oxidizer, and coolant circuits were conducted. The Phoebus-2 nozzle was successfully tested 28 February in a chemical-simulation proof-test. A Hastelloy X low-cycle fatigue specimen was tested, revealing an adequate thermal-cycle strain life at both room temperature and at –320°F. Fabrication of Nozzles continued. (auth)

28331 (RP-SR-0002) PHOEBUS-2 MATERIALS FINAL REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 434p. Dep. NTIS $24.75.

All metallurgical testing conducted in support of the Phoebus 2 Nozzle Program is summarized. The tensile properties of forgings, strip, weldments, and brazements are presented as individual test data and as statistical means with sigma limits through the temperature range of –423 to 1800°F. The mechanical properties of shear strength, bearing strength, low-cycle fatigue, and thermal cycling are also presented. In addition, the manufacturing and fabrication processes are presented from raw material melting through fabrication of individual hardware components. Metallurgical analysis of thermal treatments and processing is also provided. (auth)

28332 (RP-SR-0003) PHOEBUS-2 FINAL REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1967. 177p. Dep. NTIS $12.08.

The design, fabrication, and testing of test nozzles for the Phoebus-2 reactor are described. (JWR)

28333 (RP-SR-0003(Appx.A-E)) PHOEBUS-2 FINAL REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1967. 171p. Dep. NTIS $11.75.

The design, development, fabrication and testing of the Phoebus 2 nozzle is described in detail. These nozzles were tested by simulation using LH_2/LO_2. The development required extensive material and fabrication studies, and careful measurements of the heat transfer and pressure drop in the cooling system. Methods of locating coolant tube blockage by neutron radiography were investigated. Also, methods of repairing coolant tubes damaged in some of the experiments were developed. The test facilities developed for testing the large nozzles by chemical simulation represented a significant effort. (LTN)

28334 (RP-TM-0006) PHOEBUS-2 FUEL FILM COOLED NOZZLE DESIGN REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1966. 112p. Dep. NTIS $8.75.

The function of the fuel film cooled nozzle is to simulate a Phoebus-2 nozzle during the activation of the Aerojet-General test facility and demonstrate the operating integrity of the test assembly components under chemical simulation test conditions and to define the start transients for Phoebus-2 development nozzles. The Phoebus-2 fuel film cooled nozzle design report includes thermal and stress analyses, reliability factors, descriptions of various methods of fuel film cooling, and description of fabrication procedures with a tabulated schedule of significant events during the fabrication of two nozzles. (auth)

28335 (RP-TM-0013) PHOEBUS DEVELOPMENT NOZZLE DESIGN REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1967. 162p. Dep. NTIS $11.25.

Design information concerning the Phoebus development nozzle is reported. Criteria are presented. Supporting documentation is provided in the areas of heat-transfer, coolant flow, and nozzle shell structural analysis. A basic parts list is included. (auth)

28336 (RP-TM-0015) PHOEBUS-2 NOZZLE FLANGE BOLT COOLANT SYSTEM ANALYSIS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 16p. Dep. NTIS $4.00.

An analysis was performed to determine the adequacy of the nozzle flange-bolt coolant system and to determine the minimum total coolant flow-rate required. A fluid-dynamics analysis was performed for several total coolant flow-rates to determine the pressure drop and temperature rise as a function of flow rate. The results of these analyses were used as boundary conditions for conduction analyses of the bolts and flange. As a result of the analysis the bolt coolant flow-rate of 10 lb/sec was lowered to

4 lb/sec by LASL request. Nozzle S/N 880605 bolt coolant system has been orificed for 4 lb/sec at the calculated nozzle coolant pressure-drop of 367 psi. (auth)

28337 (RP-TM-0017) DYNAMIC STRESS ANALYSIS OF THE PHOEBUS-2 NOZZLE. Brown, P. E.; Rosser, R. C.; Schipper, J. F. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1967. 50p. Dep. NTIS $5.50.

The Phoebus nozzle is a convectively cooled component, constructed of Hastelloy X, weighing 3312 pounds. The bell mode vibrations will occur entirely in the exit cone which is a truncated conical shell. Coolant U-tubes, which do not contribute significantly to the structural strength, are embedded in the shell. The wall is a constant thickness of 0.435 inch. Dynamic analyses of the Phoebus nozzle were performed, including both resonance and response determinations for the nozzle vibrating in the typical bell modes. The maximum allowable vibratory g loadings are found and presented as a function of frequency. The nozzle is capable of withstanding a vibration in excess of ±1000 g. Since it is expected that nuclear firings will not exceed ±150 g, the nozzle has the capability to withstand nuclear firing vibrations. (auth)

28338 (RP-TR-0004) PHOEBUS-2 NOZZLE QUALITY PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1965. 70p. Dep. NTIS $6.50.

The company's organization, responsibilities, methods and plans to ensure quality in the Phoebus-2 nozzle are detailed at great length. (LTN)

28339 (RP-TR-0009) GAS-SIDE HEAT TRANSFER EXPERIMENTS ON SCALE-MODEL NUCLEAR NOZZLE WITH REACTOR-CORE SIMULATORS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1966. 71p. Dep. NTIS $6.75.

Declassified 17 Jan 1972.

A gas-side heat-transfer program for the selected Phoebus-2 nozzle contour was conducted with uncooled, subscale nozzle models having scale factors of 1/8 and 1/2. Both heated nitrogen and hydrogen were employed as working fluids at temperatures up to 1600°R. Core-exit simulators representative of the Phoebus-2 conditions were used to characterize the heat transfer from the gas flows in the region between the core-exist plane and the throat. The test data were compared with a theoretical boundary-layer model and with the empirical correlation employed for design purposes in the Phoebus-2 nozzle development effort. Through normalization of the results in terms of the coefficient, C_g, in the simplified Bartz equation, the test data indicate that heat transfer coefficients in the core exit region are higher than those predicted by the design correlation. Apparently, the hot-gas stream from the core-exit face creates enough turbulence to adversely affect the boundary layer growth, resulting in high heat transfer coefficients. (auth)

28340 (RP-TR-0012) PHOEBUS-2 TEST FAILURE REPORT, TEST NO. 1.2-15-NNN-005. Kawashige, C. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1967. 252p. Dep. NTIS $15.75.

A scheduled 16.0-second combustion test of the Phoebus-2 nozzle was terminated after 1.8 seconds because of a malfunction in the test control system. Damage was sustained by the nozzle, the nozzle-to-injector adapter, and the nozzle coolant dump line. No test stand damage, however, was incurred. The mode of failure was the loss of chamber pressure feedback to the control system: i.e., the amount of coolant supplied to the nozzle is dependent on the value of chamber pressure and loss of this information resulted in a coolant flow that was inadequate for the actual chamber pressure experienced. Investigation revealed that a loose patch cord in the data acquisition high-level patch board was the cause of failure. Twenty changes and additions to the test system are discussed. (auth)

28341 (RP-TR-0013) PHOEBUS-2 TEST SERIES 1.2-15-NNN. Kawashige, C. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 148p. Dep. NTIS $10.50.

The results of Test Series 1.2-15-NNN conducted during the period 28 February through 31 March 1967, on Test Stand H-4B, using Convectively Cooled Nozzle Test Assembly S/N 880001 are documented. The purpose was to chemically proof-test the Phoebus-2 nozzle to demonstrate its suitability for use in reactor testing. A test facility malfunction occurred on the fifth test which resulted in severe erosion of the nozzle coolant tubes. Six valves were servo-controlled during this test series to control chamber pressure, mixture ratio, nozzle coolant flow-rate, and tank pressures. The control system responded and performed as predicted throughout the test series. The failure was due to a loose patch-cord and does not invalidate the operational integrity of the system. However, as a result of the failure on Test 005, additional safeguards are being added to ensure system continuity before and during the test. Nozzle gas-side coolant tube-wall temperatures in excess of those predicted for nuclear tests were achieved in Tests 001 through 004, as evidenced by melting of braze alloys deposited on the tube crowns. The high temperatures are attributed to impingement and propellant maldistribution effects from the injector. Due to the high nozzle tube-wall temperatures attained, it is believed that the primary test objective of demonstrating ability of the Phoebus nozzle to operate at nuclear design conditions was achieved, except for sufficient test duration. (auth)

28342 (RP-TR-0015) COAXIAL INJECTOR DEVELOPMENT TEST SERIES 1.2-09-NNJ. Kawashige, C. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 124p. Dep. NTIS $9.25.

The initial test of the coaxial injector introduced some question concerning the suitability of the injector for convectively cooled nozzle testing because of suspected combustion instability. It was decided to conduct further combustion stability-evaluation tests with the film-cooled nozzle test assembly. The film-cooled nozzle was modified for installation of two flush-mounted, high-frequency Photocon transducers to monitor chamber pressure. Using these transducers as a reference, correlation with other instrumentation data could be made. This test series was also conducted to check out the controls system after extensive modifications were made and additional safety features added. Test Series 1.2-09-NNJ was conducted during the period 11–13 July 1967 on Test Stand H-4B with Film-Cooled Nozzle Test-Assembly S/N 880002. The coaxial injector (P/N 1115321-19), controls system, valve sequencing, and the malfunction detection system were determined to be suitable for Phoebus-2 nozzle proof-testing. (auth)

28343 (RP-TR-0016) PHOEBUS-2 PROOF AND MARGIN PERFORMANCE TEST SERIES 1.2-16-NNN. Wright, R. B. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1967. 328p. Dep. NTIS $19.50.

The results of Test Series 1.2-16-NNN conducted during the period 2 August 1967 through 14 August 1967, on Test Stand H-4B, using Convectively Cooled Nozzle Test Assembly S/N 880003 are reported. A total of thirteen tests were made, accumulating 92.76 seconds of steady-stage test duration. This met the requirements of Milestone No. 2 to Contract SNPC-35 and allowed one test in excees of 8 seconds steady-state duration (with nozzle coolant flow reduced to 219.9 lb/sec) to be applied toward the nozzle margin-demonstration. (auth)

28344 (TID-7653-P2(P1 and 2)) PROCEEDINGS OF NUCLEAR PROPULSION CONFERENCE, AUGUST 15–17, 1962, MONTEREY, CALIFORNIA. (Naval Postgraduate School, Monterey, Calif. (USA)). 1962. 608p. (CONF-620805-P2(P1 and 2)). Dep. NTIS $33.50.

From joint ARS/ANS/IAS nuclear propulsion conference; Monterey, California, USA (15 Aug 1962).

Declassified 16 Dec 1974.

Sixty-six papers are included on nuclear propulsion of rockets, ramjets, and space vehicles. A separate abstract was prepared for each of 65 papers. The remaining paper was previously cited in NSA as abstract 29: 20294. (HDR)

For abstracts of individual papers see: 28345–28402, 28665–28667, and 28788–28791.

28345 (TID-7653-P2(P1 and 2), pp 1-18) NUCLEAR ROCKET PROGRAM: 1962. Finger, H. B. (AEC-NASA, Washington, DC). 1962.

In proceedings of nuclear propulsion conference.

The status of the U. S. rocket reactor program as of 1962 is reviewed. (TSS)

28346 (TID-7653-P2(P1 and 2), pp 19-31) CRITICALITY AND NUCLEAR CHARACTERISTICS OF THE KIWI-A SERIES OF NUCLEAR PROPULSION TEST REACTORS. Hoogterp, J. C.; Orndoff, J. D. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The "A" series of three Kiwi test reactors for experiments contained a uranium-(93.2% ^{235}U)-loaded graphite core, a graphite reflector, and a D_2O island. Boral rods in the D_2O served as control. The core heat-exchange medium was gaseous hydrogen. The reactor was to provide a temperature and environment suitable for core material testing, instead of simulating a flyable reactor. Secondary goals were to check computed temperature effects on neutronics and to gain experience in reactor testing. The purpose of the D_2O island within the core was to reduce fuel volume and simplify control. In the interest of early results, compromise test conditions were set at a power density of 12 MW/ft^3, with maximum power at 100 MW, and exit gas temperatures in the neighborhood of 2000°C. Results are reviewed. (TSS)

28347 (TID-7653-P2(P1 and 2), pp 32-48) NEUTRONICS OF KIWI-B NUCLEAR PROPULSION REACTORS. Helmick, H. H.; Orndoff, J. D. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Neutronic studies for the design of the Kiwi-B type propulsion reactors are outlined, including: preliminary critical mockups in the Honeycomb assembly to check gross behavior; refined zero-power mockup studies to determine control characteristics and suitable U-loading distributions; and cold critical measurements on the reactor itself to confirm its characteristics, particularly to provide improved power-distribution estimates for specification of flow-passage orifices. (TSS)

28348 (TID-7653-P2(P1 and 2), pp 49-55) NEUTRONIC CALCULATIONS OF TEMPERATURE EFFECTS ON KIWI REACTORS. Plassmann, E. A. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The one-dimensional DSN neutronic code is used to reproduce the radial fission distribution measured in zero power critical mockup experiments of Kiwi reactors. The calculations are extended to predict the change in fissioning rate produced at Kiwi operating conditions. The neutronic temperature coefficient for these reactors is also predicted. (auth)

28349 (TID-7653-P2(P1 and 2), pp 56-65) ROVER REACTOR CONTROL ELEMENT WORTH CALCULATIONS. Charmatz, A. W. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Calculations were performed to determine reactivity worth of control elements in reactors suitable for rocket propulsion. The resulting approximate values were used to evaluate the feasibility of alternate control methods, for an estimate of actuator requirements, and for analyses of control system behavior resulting from individual rod motion. Configurations considered included reactors with absorbing rods located within the reactor core, as well as those using rotating control vanes located within an external reflector, and rotating vanes in both the reflector and a central moderating island. Calculations were performed to determine means of reducing power peaking at the core-reflector interface. A survey was also performed to determine an approximate upper limit on reactor power level beyond which control by neutron absorption in the reflector alone was no longer feasible. (auth)

28350 (TID-7653-P2(P1 and 2), pp 66-70) LEAKAGE RADIATION FIELDS FROM THE KIWI-B-1A. Peterson, D. M. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The QAD computer program is used to determine the leakage-radiation dose distributions from the Kiwi-B-1A reactor in a simple model. The model assumes that the reactor is divided into many small volume elements, and only the material interposed along the line of sight between the volume element and the field point need be taken into account. (TSS)

28351 (TID-7653-P2(P1 and 2), pp 71-76) DESIGN COMPUTATIONS FOR A NUCLEAR ROCKET SHADOW SHIELD. Capo, M. A. (Westinghouse Electric Corp., Pittsburgh). 1962.

In proceedings of nuclear propulsion conference.

The shield design for the NERVA engine is described. Materials investigated include LiH–U, LiH–steel, Be–steel, H_2(liquid)–U, H_2(liquid)–steel, BeO, Be–B, and graphite–B. (TSS)

28352 (TID-7653-P2(P1 and 2), pp 77-84) CALCULATIONS OF NEUTRON ACTIVATION DOSE RATES IN NUCLEAR ROCKET VEHICLES AND TEST FACILITIES. Thornton, R. M.; Butterworth, C. K. (Lockheed-Georgia Co., Marietta, GA). 1962.

In proceedings of nuclear propulsion conference.

Static testing of nuclear rockets results in neutron activation of the engine, the stage, and any other materials and structures exposed to the neutron leakage during a test. The magnitude of the gamma dose rates from activation must be considered in planning the test program, designing the test facilities, and determining the feasibility of re-use of components in the test program. Calculations are made of the activation characteristics of alloys for RIFT applications, dose rates from the RIFT stage, the NERVA engine, and several versions of a static test stand. In calculating the neutron leakage of the NERVA engine, a KIWI B-1 core configuration with a 2200-pound reactor shield is used, assuming 1120-MW power. (TSS)

28353 (TID-7653-P2(P1 and 2), pp 89-98) NEUTRON AND GAMMA ANGULAR LEAKAGE CALCULATION OF A KIWI-B REACTOR. Prescott, A. D. (George C. Marshall Space Flight Center, Huntsville, AL). 1962.

In proceedings of nuclear propulsion conference.

The numerical gamma and prompt-neutron angular flux distributions are computed at distances of 1.5 and 4.5 m from the center of the Kiwi-B1 reactor operating at 1 kMW. The computer uses moments-method differential energy spectra data. The results agree with the Monte Carlo results within 13%, and are obtained in about $\frac{1}{20}$ of the computer time required for the Monte Carlo results. (TSS)

28354 (TID-7653-P2(P1 and 2), pp 99-103) NOVEL RADIATION CALCULATIONS ON ROCKET REACTORS. Malenfant, R. E. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The use of a computer code to compare the local heating rates in B_4C–Al and EuO_2–Al control elements in the Kiwi-B reactor is described. The heating rate in the latter type of control element is found to be about 5% of that in the former. The same code is used to determine the photoneutron production rates in the Be reflector of the Kiwi-B reactor, both during operation and post-shutdown. (TSS)

28355 (TID-7653-P2(P1 and 2), pp 104-108) TRANSPORT CALCULATIONS OF THE KIWI-B NEUTRON ENVIRONMENT. McCutchan, D. A. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Several one-dimensional transport-theory calculations are made for Kiwi-B-1, using the DSN code. Some results are given concerning the reactor's overall neutron economy, interior flux, and leakage currents. To gain information about the high-energy reactor spectrum, five high-energy groups are developed. The data reported are all based on a revised 27-group cross-section set using these five groups. (TSS)

28356 (TID-7653-P2(P1 and 2), pp 109-114) RADIATION INDUCED CONVERSION OF ORTHOHYDROGEN TO PARAHYDROGEN ON THE RIFT PROPELLANT TANK. Johnson, M. C. (Bendix Corp., Southfield, MI). 1962.

In proceedings of nuclear propulsion conference.

Calculations are carried out that show that the radioinduced conversion of o-H_2 to p-H_2 in a tank of liquid H_2 produces heating that is probably insignificant compared to the nuclear heating involved. The radiation is assumed to originate in a NERVA rocket engine. (TSS)

28357 (TID-7653-P2(P1 and 2), pp 115-119) STARTUP STUDIES OF A NUCLEAR ROCKET REACTOR. Balcomb, J. D. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The range of startup profiles for the Kiwi-B reactors is studied, with particular attention to the reactivity worth of liquid and gaseous hydrogen passing through the core. (TSS)

28358 (TID-7653-P2(P1 and 2), pp 128-137) DESIGN AND EVALUATION OF ELECTROPNEUMATIC SERVO ACTUATORS FOR THE NERVA ENGINE. Schaffer, D. J.; Wetzel, A. J. (Bendix Corp., South Bend, IN). 1962.

In proceedings of nuclear propulsion conference.

Types of control actuators developed for use in the environments of the NERVA engine are discussed. Described are the major functional requirements and the approach to the design and analysis of sub-systems to accomplish these functions. The factors affecting the design approach as well as basic sizing criteria are reviewed. Data showing the status of development tests on components and materials for applicability to the temperature, nuclear, and working fluid environment are presented. Analytical and test data are compared to indicate the validity of the mathematical models used to evaluate performance. (auth)

28359 (TID-7653-P2(P1 and 2), pp 138-143) CONTROL AND TELEMETRY TRANSDUCER REQUIREMENTS FOR NUCLEAR POWERED VEHICLES. Johnson, M. C. (Bendix Corp., South Bend, IN). 1962.

In proceedings of nuclear propulsion conference.

Major problems and possible solutions are discussed in the development of telemetry transducers for SNAP, SLAM, and Rover vehicles. The relation of the required technology of the state-of-the-art is noted in these cases. (TSS)

28360 (TID-7653-P2(P1 and 2), pp 163-176) RE-ENTRY OF NUCLEAR ROCKETS INTO EARTH'S ATMOSPHERE. Weiner, R. I. (Martin Co., Baltimore). 1962.

In proceedings of nuclear propulsion conference.

Techniques and results are presented of a study of nuclear rocket reentry into the earth's atmosphere owing to orbital and suborbital aborts. Two cases are analyzed; an explosive destruct system is assumed to fracture the core into a subcritical assembly, and the initial size of particles that could be reduced to 25 microns at 100,000 feet by passive aerothermochemical means is determined. Both continuum-flow and free-molecule-flow estimates are made, and it is found that the initial sizes of debris at destruction would have to be between $\frac{1}{24}$ and $\frac{1}{18}$ inch in diameter to satisfy the boundary conditions imposed on the solution. The second case considered is the possibility of destruct system failure and the reentry of the intact engine from orbital and suborbital aborts. It is determined that the engine will reenter intact from any aborts below 400,000 feet and for any aborts above this altitude, engine afterheat (not aeroheating) is the primary mode of engine structural failure. In addition, not enough energy or expo-

sure time is available in any of the ballistic or orbital injection mission aborts studied to appreciably destroy the engine fuel elements or reflectors that fall free after a pressure vessel meltdown. (auth)

28361 (TID-7653-P2(P1 and 2), pp 177-183) NUCLEAR ROCKET DESTRUCT SYSTEM REQUIREMENTS. Esselman, W. H. (Westinghouse Electric Corp., Pittsburgh). 1962.

In proceedings of nuclear propulsion conference.

The dispersion and diminution of parts of nuclear-rocket reactors is studied during reentry, following destruction of the reactor in space. The study is carried out by computer analyses, and the results are used to define destruct-system criteria. (TSS)

28362 (TID-7653-P2(P1 and 2), pp 215-225) TRANSIENT REACTOR EXPERIMENTS ON NERVA FUEL MATERIAL. Boltax, A.; Liimatainen, R. C.; Vogel, M. A.; Ivins, R. O.; Wilks, P. H. (Westinghouse Electric Corp., Pittsburgh). 1962.

In proceedings of nuclear propulsion conference.

An experimental program to determine the feasibility of using a reactor transient to destroy the core of a nuclear rocket is described. The technical approach involves transient irradiation of unrestrained sections of NERVA (Kiwi B-4 type) fuel elements in the TREAT reactor. Transient irradiation experiments are performed in helium, vacuum, and water environments on fueled graphite made with either UO_2 powder or pyrolytic carbon coated UC_2 particles. The data obtained include nuclear excursion data, fuel temperature, threshold energy values for fuel fragmentation, particle size of fuel fragments, and fission xenon release. The results indicate that fragmentation of the fueled graphite made from UO_2 powder will occur during TREAT excursions of 100 to 770 megawatt-seconds (Mws). The NERVA-equivalent fragmentation values range from 1,000 to 11,000 Mws. Preliminary results obtained on the fueled graphite containing coated UC_2 particles indicate that it is more resistant to fragmentation than fuel made with UO_2 powder. (auth)

28363 (TID-7653-P2(P1 and 2), pp 226-235) EFFECTS OF LIQUID PROPELLANT EXPLOSIONS ON NUCLEAR ROCKET ENGINES. Bastress, E. K. (Little (Arthur D.) Inc., Cambridge, MA). 1962.

In proceedings of nuclear propulsion conference.

An experimental program was conducted to determine blast effects from explosions of liquid rocket propellants. One phase of the program was concerned with the internal characteristics of propellant explosions and their effects on nuclear rocket engines. The purpose of this phase was to determine the hazards that might result from a failure at launch of a large liquid-propellant booster rocket with a nuclear-powered upper stage. A variety of instruments were used to measure peak-pressures and heat transfer rates within propellant explosions. In addition, observations were made during each test of the movements of the fireball and dust-cloud, and of the fragmentation and scattering of debris. Measured characteristics of propellant explosions were utilized to predict their effects on nuclear rocket engines of the NERVA type, and to determine the hazards that might arise from distortion of the engine or vaporization of reactor components. Hazards considered were blast, radioactivity, dispersion of toxic materials, and scattering of reactor fragments. As a result of this analysis it was concluded that incorporation of a NERVA engine in a SATURN vehicle is not likely to create a hazard to personnel or property beyond safe distances required for propellant blast effects. (auth)

28364 (TID-7653-P2(P1 and 2), pp 236-244) LOS ALAMOS SCIENTIFIC LABORATORY ROVER FLIGHT SAFETY PROGRAM. King, L. D. P. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Safety problems and possible solutions encountered in the flight of the Rover rocket reactor are outlined. (TSS)

28365 (TID-7653-P2(P1 and 2), pp 245-253) DESTRUCT SYSTEM FOR THE NERVA ENGINE. Kreyenhagen, K. N.; Thiel, W. H.; Yoder, S. K. (Aerojet-General Corp., Azusa, CA). 1962.

In proceedings of nuclear propulsion conference.

High explosives represent a promising source of energy, both for reducing the NERVA reactor core to sub-critical masses in the event of booster malfunction, and for disposing of the reactor after operation so that contamination will be prevented. Several design concepts are possible for the pre-operation requirement, including the use of linear explosive charges and shaped charges for cutting open the pressure hull and dispersing the core rods. The post-operational requirement is more difficult, since the 3000-pound core must be broken up into fragments of approximately one mm major dimension. Various concepts are explored, utilizing external charges of explosives as well as charges which are propelled into the reactor prior to detonation. The feasibility of accomplishing the required fragmentation with reasonable masses of explosive is studied. Experiments are also performed to assess the physical and chemical changes that will occur in explosives when they are subjected to the radiation environment around the NERVA reactor. (auth)

28366 (TID-7653-P2(P1 and 2), pp 254-263) E-MAD FACILITY DESIGN CONCEPT. Hellman, S. K. (Vitro Engineering Co., New York). 1962.

In proceedings of nuclear propulsion conference.

The design concept of the E-MAD (nuclear-rocket Engine Maintenance, Assembly and Disassembly) facility is defined, in terms of size, capability, and operational characteristics. The facility's design is predicted upon its use with NERVA engines. (TSS)

28367 (TID-7653-P2(P1 and 2), pp 264-272) KIWI-B-1A FULL-POWER TEST. Brown, D. W. (Los Alamos Scientific Lab., NM); Cerni, S. 1962.

In proceedings of nuclear propulsion conference.

A test run of the Kiwi-B-1A reactor is described, in which the reactor operated for 36 sec at a power of 225 Mw and a hydrogen coolant flow rate of 20 lb/sec. The reactor is described, and the data accumulated during the run are outlined. (TSS)

28368 (TID-7653-P2(P1 and 2), pp 273-280) KIWI-B-1A TEMPERATURE-REACTIVITY EFFECTS. Demuth, H. B.; Stiles, C. E.; Perry, J. E. Jr. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The Kiwi-B-1A exhibited peculiar temperature-reactivity variations during its final runs. An analysis of the unusual effects was made by reconstructing the runs on an analog computer model of the reactor system. The data on reactor power, hydrogen flow rate, control rod positions, and exit gas temperature were used as input data and the analog model was used to decompose reactivity into its various separable components. The reactor phenomena, the methods of the investigation, and results are reviewed. (TSS)

28369 (TID-7653-P2(P1 and 2), pp 281-290) KIWI-A PRIME DISASSEMBLY. Anderson, D. B.; Montgomery, C. D.; Ramsey, E. B.; Swink, M. N. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The steps in the remote handling and disassembly of the Kiwi-A' reactor following testing are enumerated and evaluated. (TSS)

28370 (TID-7653-P2(P1 and 2), pp 291-298) DESIGN CONSIDERATIONS IN THE DEVELOPMENT OF THE LIQUID HYDROGEN FEEDSYSTEM FOR KIWI-B. Bohl, R. J.; Brown, E. A.; Milich, C. P.; Nutter, M. J. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

A turbopump liquid-hydrogen feed-system suitable for the Kiwi-B and NERVA engines is described. The turbopump-speed and flow-rate control systems are described. The differential equations governing the feed-system are discussed. (TSS)

28371 (TID-7653-P2(P1 and 2), pp 299-301) TORY II-C ASSEMBLY TECHNIQUES. Williams, A. W. (Univ. of California, Livermore). 1962.

In proceedings of nuclear propulsion conference.

Problems expected in the two-phase (ceramic core first, reactor hardware second) assembly of the Tory II-C reactor are outlined and evaluated. (TSS)

28372 (TID-7653-P2(P1 and 2), pp 302-309) BRITTLE FRACTURE ANALYSIS AND THE KIWI-B-2A CORE SUPPORT DISC DESIGN. Rowley, J. C. (Los Alamos Scientific Lab., NM); Brussalis, W. G. 1962.

In proceedings of nuclear propulsion conference.

The Kiwi-B-2A support disc is analyzed by means of the statistical theory of brittle fracture. (TSS)

28373 (TID-7653-P2(P1 and 2), pp 310-318) ANALYSIS FOR THE SPECIFICATION OF TEMPERATURE AND FLOW DEPENDENT DESIGN PARAMETERS IN KIWI-B REACTORS. McClary, J. A. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Criteria and analytic methods for specifying certain dimensions, which determine the distributions of propellant flow, propellant temperature, and material temperature in Kiwi-B reactors, are reviewed. These criteria include temperature uniformity, power densities, and inlet and outlet pressures. (TSS)

28374 (TID-7653-P2(P1 and 2), pp 319-327) NERVA REACTOR MECHANICAL DESIGN. Selz, A.; Manjoine, M. J. (Westinghouse Electric Corp., Pittsburgh). 1962.

In proceedings of nuclear propulsion conference.

Basic rules governing the design of the NERVA engine are discussed. The NERVA reactor, which is a design extension of the Kiwi reactors, is described. (TSS)

28375 (TID-7653-P2(P1 and 2), pp 328-330) TORY II-C SYSTEM. Walter, C. E.; Myers, W. B.; Reynolds, H. L. (Univ. of California, Livermore). 1962.

In proceedings of nuclear propulsion conference.

The Tory II-C system consists of four components: reactor; reactor control; mobile test bed; and test facility. The system is designed for flight conditions, but is to be ground tested only. Operations of the system and test facility are outlined. (TSS)

28376 (TID-7653-P2(P1 and 2), pp 331-333) INTERNAL SUPPORT PROBLEMS IN A HIGH-TEMPERATURE AIR-COOLED REACTOR: TORY II-C. O'Neal, W. C. (Univ. of California, Livermore). 1962.

In proceedings of nuclear propulsion conference.

The distribution of the internal loads in the support system of the Tory II-C reactor is described. The pressure-drop load is carried by the forward support grid, which operates cooler than the aft support grid. (TSS)

28377 (TID-7653-P2(P1 and 2), pp 334-336) PRESSURE REQUIREMENTS FOR THE LATERAL SUPPORT OF A REACTOR. Platt, E.; Miller, A. (Univ. of California, Livermore). 1962.

In proceedings of nuclear propulsion conference.

A calculation is made of the side pressure required to keep the fuel elements of a reactor in place. The problem is peculiar to high-temperature reactors that have small, bundled elements. The principal transverse forces arise from body forces. It is desired to restrain necessary thermal growth as lightly as the requirements of array stability will allow. (TSS)

28378 (TID-7653-P2(P1 and 2), pp 337-345) STARTUP STUDIES OF A NUCLEAR ROCKET REACTOR. Part 2. Cryogenic Cooldown Experiments. Watts, G. P.; Lyle, A. R.; Balcomb, J. D. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

In order to gain a better understanding of the two-phase flow characteristics of hydrogen under conditions similar to those encountered in startup, some experiments were undertaken. The experiments were to serve two functions: to check digital codes devised to describe the behavior of hydrogen throughout the reactors; and to provide a basis for starting Rover reactors in case it is impossible to develop adequate codes. Since it was desired to restrict liquid and two-phase hydrogen to the reflector of the reactor, the experiments were designed principally to study phenomena in the reflector. (TSS)

28379 (TID-7653-P2(P1 and 2), pp 346-354) DECAY HEAT COOLING ANALYSIS OF A NUCLEAR ROCKET ENGINE. Howarth, W. L.; Retallick, F. D. (Westinghouse Electric Corp., Pittsburgh). 1962.

In proceedings of nuclear propulsion conference.

Continuous and pulse-flow methods for removing the decay heat from the NERVA engine are compared. It is found that the determination of which of these methods is the more efficient is dependent on the mission involved. (TSS)

28380 (TID-7653-P2(P1 and 2), pp 355-364) EXPERIMENTAL HEAT TRANSFER COEFFICIENTS IN CONTOURED NOZZLES. Kasahara, M.; Mandell, B.; McFarland, B. L. (Aerojet-General Corp., Azusa, CA). 1962.

In proceedings of nuclear propulsion conference.

A test program was conducted to obtain data on heat-transfer rates to a specific nozzle contour; for these tests, $\frac{1}{11}$ and $\frac{1}{4}$ scale-model contoured nozzles were used with hot nitrogen gas as the working fluid. A thin-walled nozzle was used as the test device and fully thermocoupled to obtain heat transfer by measuring the wall temperature as a function of time. An ejector duct was used to maintain full flow in the nozzle and two types of calorimeters were used to check the heat-transfer data. The test data were compared with several turbulent-flow boundary-layer correlations. No one correlation adequately predicted heat-transfer conditions throughout the nozzle, although one equation, when modified to account for the three-dimensional flow distribution, was a reasonable representation of the test data. (auth)

28381 (TID-7653-P2(P1 and 2), pp 371-377) HIGH TEMPERATURE TESTING OF Mo–UO_2 AND W–UO_2 CERMETS. Lenz, W. H.; Mundinger, P. R. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Work directed toward the testing of fuel elements for a nuclear propulsion reactor is discussed. The test specimen was approximately 0.4 × 0.6 in. The thickness varied greatly in the Mo–UO_2 work, but was near $\frac{1}{16}$ in. for all the W–UO_2 tests. For the high-temperature test, the specimen was suspended in a tungsten tube heated by resistance. Hydrogen gas, preheated by passing through a heated Mo coil, was passed through the tungsten tube at a rate of 7 liters per minute. Temperatures were read optically directly on the specimen by sighting through a small hole in the W tube. (TSS)

28382 (TID-7653-P2(P1 and 2), pp 378-381) REFRACTORY CARBIDES AS PROTECTIVE COATINGS ON GRAPHITE FUEL ELEMENTS. Bowman, M. G. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The protective effects of various refractory carbides against hydrogen corrosion of graphitic rocket-reactor components are compared. TaC offers the best protection, but has a high neutron-capture cross section. NbC and ZrC follow TaC in order of decreasing protective effect and neutron-capture cross section. (TSS)

28383 (TID-7653-P2(P1 and 2), pp 382-393) HIGH TEMPERATURE LIGHT WEIGHT NEUTRON SHIELDING MATERIALS FOR NUCLEAR-SPACE POWER PLANTS. Baxter, W. G.; Welch, F. H. (General Electric Co., Cincinnati). 1962.

In proceedings of nuclear propulsion conference.

Several high-temperature lightweight shielding materials were investigated as part of the direct-cycle nuclear powered aircraft program. A fabrication development program was conducted on lithium hydride for application at temperatures to 1000°F and beryllium with 1 weight percent (wt %) natural boron for temperature to 1400°F. This effort was supported by a physical-property, including in-pile, testing program. Significant results of this program included: the successful fabrication of a unit casting of lithium hydride weighing 950 pounds in a pre-formed thin sheet metal stainless steel container; and the development of a protective coating that permitted Be–B (1 wt %) samples to successfully operate in air at a temperature of 1400°F in excess of 1000 hours. (auth)

28384 (TID-7653-P2(P1 and 2), pp 394-403) PROTECTIVE COATING TECHNOLOGY FOR KIWI FUEL ELEMENTS. Winburn, D. C.; Money, R. K. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Methods for depositing protective coatings of NbC on Kiwi-reactor fuel elements are described. (TSS)

28385 (TID-7653-P2(P1 and 2), pp 404-410) COMPRESSIVE CREEP OF CERAMICS FOR HIGH-TEMPERATURE NUCLEAR REACTORS. Vandervoort, R. R.; Barmore, W. L. (Univ. of California, Livermore). 1962.

In proceedings of nuclear propulsion conference.

One phase of the high-temperature mechanical properties of beryllium oxide, namely, the compressive creep, is studied. The purpose of the investigation is to evaluate the basic relations between creep rate and temperature, stress, and uranium oxide content. (TSS)

28386 (TID-7653-P2(P1 and 2), pp 411-420) QUALITY OF ROVER FUEL ELEMENTS AS DETERMINED BY NONDESTRUCTIVE TEST METHODS. Tenney, G. H. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Methods used for the production and post-mortem nondestructive inspection of Rover fuel elements are summarized. (TSS)

28387 (TID-7653-P2(P1 and 2), pp 421-426) FABRICATION OF URANIUM LOADED GRAPHITE FUEL ELEMENTS FOR THE KIWI-B-4 REACTOR. Martin, W. W.; Schell, D. H.; Taylor, J. W. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The core of the Kiwi-B-4 reactor was composed of extruded graphite pieces that were hexagonal in cross-section. These pieces were about $\frac{3}{4}$ in. across the flats and $52\frac{9}{64}$ in. long. The majority of the pieces were loaded with highly enriched U, and most of these pieces contained 19 longitudinal holes 0.093 in. in dia. Two hundred sixty-five pieces were unloaded and contained a central longitudinal hole $\frac{9}{16}$ in. in dia. Six of the U-loaded fuel elements were placed around a hexagonal unloaded piece to form a 7-piece cluster. This cluster was supported by a graphite support block and the entire assembly was hung from the cold end of the reactor by a stainless steel rod, which passed through the hole in the unloaded piece. The fuel elements were formed by extruding a graphite mix, containing enriched U, through a die having 19 core pins, thus forming the 19 holes. The extrusions were heat treated to cure and decompose the resin binder, convert the UO_2 to U carbides, and graphitize the elements. (TSS)

28388 (TID-7653-P2(P1 and 2), pp 427-435) CHEMICAL AND METALLOGRAPHIC EVALUATION OF URANIUM COMPOUNDS INCORPORATED INTO GRAPHITES. Lyon, L. L.; Hoffman, C. G. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Various methods of incorporating uranium compounds into

graphite matrices are investigated. The uranium-loaded graphites are evaluated for possible use in reactors for nuclear propulsion operating above 2000°C with hydrogen as the propellant. The desirable requirements for a uranium-loaded graphite nuclear propulsion fuel element are that: the uranium compound be compatible with the extrusion process conditions needed to make a high-strength, high-density graphite; protective coatings preventing hydrogen attack can be applied; the elements have good chemical and physical stability upon exposure to extreme atmospheric conditions and upon exposure to trace impurities in the gases used during start-up and cooldown operations; and during reactor operation the element should not lose uranium or carbon by any physical or chemical transport mechanisms. (auth)

28389 (TID-7653-P2(P1 and 2), pp 436-445) BeO-BASE FUEL ELEMENTS FOR USE IN AIR TO 1650°C. Turner, P. P.; Bohlander, K. M.; Fitzsimmons, E. S.; Joseph, R. A. (General Electric Co., Cincinnati). 1962.

In proceedings of nuclear propulsion conference.

It is shown that BeO-based materials containing fuel additives in the $UO_2-Y_2O_3-ZrO_2$ system exhibit excellent fuel retention in air at least to 1650°C. In particular, elements containing 6 wt % UO_2 show only 2 to 4 wt % loss after 400 hr at 1650°C. These fuel elements sinter to 98.0 to 98.5% theoretical density in 2 hr at 1625 to 1675°C and have a room-temperature modulus of rupture of 35 kpsi. Elements containing 10 wt % UO_2 exhibit excellent fuel retention and strength at 1650°C. Fuel elements with 14-micron grain size show less than 4% deformation after 300 hr at 1 kpsi and 1510°C. (auth)

28390 (TID-7653-P2(P1 and 2), pp 446-453) FABRICATION OF CLAD TUNGSTEN–UO_2 FUEL PLATES. Schuetz, T. J.; Eiss, A. L.; Frank, L. (Martin-Marietta, Baltimore). 1962.

In proceedings of nuclear propulsion conference.

The preparation of W-clad W–UO_2 dispersion fuel plates from powders is described. The powders are blended, compacted into plates, sintered, rolled, and flattened. (TSS)

28391 (TID-7653-P2(P1 and 2), pp 454-462) INVESTIGATION OF TUNGSTEN AND URANIUM DIOXIDE AS A NUCLEAR ROCKET FUEL MATERIAL. Saunders, N. T.; Watson, G. K.; Buzzard, R. J. (National Aeronautics and Space Administration, Cleveland). 1962.

In proceedings of nuclear propulsion conference.

Material properties such as compatibility, fuel containment, and fabricability were investigated for the tungsten–urania system to evaluate the feasibility of this system for nuclear fuel uses. A summary of data obtained is presented along with some discussion of future problem areas. (TSS)

28392 (TID-7653-P2(P1 and 2), pp 463-472) MANUFACTURE AND PROPERTIES OF GRAPHITE–URANIUM CARBIDE FUEL ELEMENTS. Eiss, A. L.; Schuetz, T. J.; Frank, L.; Siegel, A. R. (Martin-Marietta Corp., Baltimore). 1962.

In proceedings of nuclear propulsion conference.

The fabrication of graphite–UC fuel elements having U loadings up to 900 mg/cm^3 is described. The physical and mechanical properties of the finished product are described. (TSS)

28393 (TID-7653-P2(P1 and 2), pp 473-477) LIQUID HYDROGEN PUMPS AND FEED SYSTEMS FOR NUCLEAR ROCKET REACTOR EXPERIMENTS. Part 1. The Axial-Flow Liquid Hydrogen Pump. Huppert, M. C.; Watelet, R. P. (Rocketdyne, Canoga Park, CA). 1962.

In proceedings of nuclear propulsion conference.

The use of liquid hydrogen as a rocket propellant shows the need for pumps with a developed head capability greater than that provided with conventional pumps. A multistage axial-flow pump for hydrogen application is described. Its design features and performance capabilities are discussed. (TSS)

28394 (TID-7653-P2(P1 and 2), pp 478-489) LIQUID HYDROGEN PUMPS AND FEED SYSTEMS FOR NUCLEAR ROCKET REACTOR EXPERIMENTS. Part II. Feed Systems. Huppert, M. C.; Watelet, R. P. (Rocketdyne, Canoga Park, CA). 1962.

In proceedings of nuclear propulsion conference.

Descriptions are given of several liquid-hydrogen feed systems for nuclear rocket use. (TSS)

28395 (TID-7653-P2(P1 and 2), pp 490-501) DESIGN OF KIWI-B TYPE NUCLEAR ROCKET REACTOR PRESSURE VESSELS, WITH NOTES PERTAINING TO OPTIMUM PRESSURE VESSEL DESIGN. Neudecker, J. W.; Pozega, R. E. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The design philosophy is set forth that dictates the design of the Kiwi-B series reactor pressure vessels. The operating environment for these pressure vessels is discussed, and the analytical tools used in the structural analyses are described. The structural tests of a pressure vessel design are described and a comparison is made between the theoretical analysis of the pressure vessel and the structural test results. A suitable design for reactor pressure vessels is shown, and the optimization factors are discussed. (TSS)

28396 (TID-7653-P2(P1 and 2), pp 502-514) SOME DESIGN CONSIDERATIONS OF COOLING SYSTEMS FOR NUCLEAR ROCKET NOZZLES UNDER SEVERE THERMAL CONDITIONS. Sellers, J. P.; McFarland, R. D. (Rocketdyne, Canoga Park, CA). 1962.

In proceedings of nuclear propulsion conference.

Although hydrogen is an excellent coolant, it is expected that hydrogen regenerative cooling of solid nuclear rocket nozzles should become marginal between 800 and 1000 psia chamber pressure. Refractory metals, if they can be used, only increase this upper range by a limited extent, because the thermal stresses greatly exceed the yield strength of the material. As a means of diminishing the heat flux and the temperature gradients, insulating coatings do not appear as promising as internal cooling. Film cooling alone requires a theoretical coolant flow rate that is excessive. Although not substantiated by analysis, combining film cooling and regenerative cooling would seem to be a practical means of significantly reducing the required internal coolant flow rate. (auth)

28397 (TID-7653-P2(P1 and 2), pp 515-523) CONSIDERATIONS IN THE DESIGN AND CHOICE OF MATERIAL FOR ROVER PRESSURE VESSELS. Martin, L. P.; Johnson, R. T. (ACF Industries, Inc., Albuquerque, NM). 1962.

In proceedings of nuclear propulsion conference.

The effects of internal heat generation within the vessel walls on the vessel design are discussed. Factors affecting the choice of vessel material (reactor physical design requirements; mechanical, physical, and nuclear properties of the structural alloys; and availability and fabricability of the alloys) are analyzed. The analysis is devoted to reactors in the power range of Kiwi-B and beyond. (TSS)

28398 (TID-7653-P2(P1 and 2), pp 524-535) DESIGN AND TESTING COLUMBIUM-1 ZIRCONIUM REACTOR PRESSURE VESSELS. Bigelow, C. C. (United Aircraft Corp., Middletown, CT). 1962.

In proceedings of nuclear propulsion conference.

Conservative design criteria for low-weight (Nb–1% Zr) reactor pressure vessels are described. Tests for validating these criteria are outlined. (TSS)

28399 (TID-7653-P2(P1 and 2), pp 536-545) NUCLEAR ROCKET ENGINE CYCLE SELECTION. Vanica, D. F. (Aerojet-General Corp., Azusa, CA). 1962.

In proceedings of nuclear propulsion conference.

Criteria are given for choosing between hot-bleed, heated-bleed, and topping cycles for feeding propellant through nuclear rockets in the thrust range above 55,000 lb. (TSS)

28400 (TID-7653-P2(P1 and 2), pp 558-566) COMBINED NUCLEAR AND CHEMICAL PROPULSION CYCLES HAVING HIGH SPECIFIC IMPULSE. Chapman, R. L.; Mossman, E. A. (Martin-Marietta Corp., Denver). 1962.

In proceedings of nuclear propulsion conference.

A chemical/nuclear rocket concept is described that shows promise of meeting the requirements as a space booster system. Three engine cycles based on this concept are discussed. They require the release of chemical energy through combustion and the release of nuclear energy from a reactor. Though these cycles operate in the atmosphere, the nuclear heat source could also be used for propulsion of later vehicle stages. (TSS)

28401 (TID-7653-P2(P1 and 2), pp 567-579) LIQUID HYDROGEN BEHAVIOR WITH HEAT ADDITION DURING WEIGHTLESSNESS. McArdle, J. G.; Nunamaker, R. R. (National Aeronautics and Space Administration, Cleveland). 1962.

In proceedings of nuclear propulsion conference.

The effects of periods of weightlessness in excess of 4 min, in conjunction with heat addition, on the equilibrium shapes, pressures, etc. of liquid hydrogen are described. (TSS)

28402 (TID-7653-P2(P1 and 2), pp 580-589) OPTIMIZATION OF NUCLEAR ROCKET POWERPLANT PARAMETERS. Johnson, P. G.; Cowgill, G. R.; Miser, J. W. (National Aeronautics and Space Administration, Cleveland). 1962.

In proceedings of nuclear propulsion conference.

Flight performance of a nuclear rocket spacecraft is determined by the characteristics of its many powerplant and vehicle components. Interactions among the components are such that optimum combinations of parameters can be found, using maximum payload as the measure of merit in the optimization process. A study is made of the optimization of reactor flow area, reactor-

exit pressure, and reactor length. A million-pound orbital-launch stage is assumed, and the specified mission is the first propulsion period of a fast round trip to Mars. Vehicle performance is shown to be relatively insensitive to variations in the optimization parameters. The attainment of high specific impulse is shown to be an important factor in parameter selection, more important than the achievement of minimum reactor size or minimum power-plant specific weight. (auth)

28403 (TID/SNA-10) SYSTEMATIC APPROACH TO SELECTION, DESIGN, DEVELOPMENT, AND PRODUCTION OF COMPONENTS FOR AN OPTIMIZED ENGINE. Campbell, W. E.; Braun, E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Oct 1968. 53p. Dep. NTIS $5.75.

A series of slides presented at a briefing are documented with respect to achieving reliability through design and testing, stress analysis, etc. (LTN)

28404 (TID/SNA-12) NERVA DATA AND DOCUMENT MANAGEMENT CONTROL PLAN C-100. (Aerojet-General Corp., Sacramento, Calif. (USA)). 30 Sep 1969. 64p. Dep. NTIS $6.25.

The requirements for data management in the NERVA Program are established in the SNPO-prepared NERVA Program Requirements Document, SNPO-NPRD-1 and its appendices. Objectives of data management are to provide visibility to the decision-making process. It encompasses the significant phases of the communications used in the design, development, qualification and delivery of the NERVA Engine System, its subsystems, components and supporting equipment and facilities. An additional objective of data management is to enhance the communications process within prime contractor's, principal subcontractor's and other contractors' operation; between these contractors and between the contractors and the Government. This is accomplished by controlling both data and documents, retaining the information, and delivering it upon demand or according to predetermined schedules in support of program needs. As an integral part of controlling data and documents, the data management program must provide an effective means for determining the security classification of the data as it is generated and maintaining proper control over the storage and dissemination of classified data. Since many types of data are needed in the NERVA Program, Data Management must consolidate data from both random and selected sources. It must develop and use data systems which provide useful reports for both programmatic and specialized purposes. And this must be done at a reasonable cost to the program. One of the important contributions data management can make to the NERVA Program is cost reduction through the elimination of duplicate data. Also by providing useful data, conveniently, and on a timely basis, an effective data management program can minimize the chances of duplicate effort associated with "reinvention." (auth)

28405 (TID/SNA-13) WANL XE-1 CONTROLS READINESS REVIEW. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 Mar 1968. 57p. Dep. NTIS $6.00.

Slides presented at an XE-1 controls readiness review are documented. The reasons for selection of special equipment are given, special problems are discussed, and the status of equipment not ready is reported. The equipment involved is that at test stand No. 1 for testing the XE-1 reactor. (LTN)

28406 (TID/SNA-15) JUSTIFICATION OF TURBOPUMP DESIGN, e105-TPA03-W121f16. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 330p. Dep. NTIS $19.50.

The preliminary design effort, with the exception of the structural and thermal analysis, expended on the NERVA Turbopump Assembly (TPA) during the time period from 1 May 1970 to 1 September 1970 is described. The structural and thermal analysis effort accomplished during this time period is documented in Engineering Data Items S-36 and S-31, respectively. The basis and derivation of the design requirements are briefly discussed. The TPA Trade Study, from which the selected concept was derived, is summarized. Detailed discussions are presented on the fluid dynamic design of the pump and turbine. The mechanical design section presents the results of the work accomplished on bearings, rotor assembly, housings, axial thrust balance, seals and labyrinths, bearing filter system, pump chill-down, reliability, weights and materials, TPA interface connections, and instrumentation. (auth)

28407 (TID/SNA-25) s031-EAN01-W141f26: THERMAL AND FLUID FLOW ANALYSIS REPORT. Volume I. NERVA Nozzle Coolant Channels. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 152p. Dep. NTIS $10.75.

28408 (TID/SNA-27) E105-CP090290-F1: ENGINEERING DATA FOR DESIGN EVALUATION. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 401p. Dep. NTIS $23.25.

Engineering data prepared for evaluation of the NERVA engine design is presented. (JWR)

28409 (TID/SNA-31) S052-CP090205-F1: FUNCTIONAL FLOW DIAGRAM. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 96p. Dep. NTIS $8.00.

Complete function flow diagrams are presented for the preparation and execution of NERVA missions. (JWR)

28410 (TID/SNA-42) NERVA ENGINE STATUS PRESENTATION. First Interim Briefings, Nuclear Shuttle System Definition Study, Phase III. Marshall Space Flight Center, Huntsville, Alabama. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 3 Sep 1970. 82p. Dep. NTIS $7.25.

28411 (TID/SNA-44) S023, S023-CP090290AF1: NERVA ENGINE NATURAL ENVIRONMENT. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 154p. Dep. NTIS $10.75.

The NERVA engine shall be capable of rated operation after being subjected to all ground, launch, and flight environments. To achieve this capability, the process of developing engine design requirements must include an evaluation of all environmental factors which might affect engine operation and/or function. This document defines the natural environments to which the NERVA engine may be exposed and, by means of functional analysis, develops in quantitative terms the environmental parameters to be considered in establishing engine design requirements. Mission functions were developed through analysis of Functional Flow Diagrams, Requirements Allocation Sheets and Time Line Sheets. Natural environment definitions were developed in part from the data of SNPO-C-6, which provides guideline data on natural environments for the various geographic and space locations applicable to the NERVA engine. (auth)

28412 (TID/SNA-45) SUMMARY REPORT: DEVELOPMENT PROBLEMS ASSOCIATED WITH THE BENDIX MODEL NT-D2 TURBINE-POWER-CONTROL-VALVE ACTUATOR. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 476p. Dep. NTIS $27.00.

The resolution of problems associated with the development of the Bendix Model NT-D2 turbine-power-control-valve (TPCV) actuator is discussed. First, it was necessary to isolate the problems pertaining to the individual components of the TPCV actuator: the servovalve, transmission, output shaft seal, gear-motor, and potentiometer adapter. Problem solving and necessary modifications then proceeded based on straightforward engineering analysis and testing of the components and the completed assembly. Pertinent historical data and supporting documentation pertaining to test procedures and methods used in developing the modified TPCV actuator is presented. (auth)

28413 (TID/SNA-49) NERVA SAFETY PLAN, S-019, S019-SS-090205-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 184p. Dep. NTIS $12.25.

This safety plan was prepared to satisfy the basic safety requirements of Contract SNP-1, the specific safety requirements of the NERVA Program Requirements Document, the safety regulations established by the AEC and SNPO, and applicable policies as set forth by the Aerojet-General Corporation and the Westinghouse Electric Corporation. The NERVA safety plan defines a total integrated approach to safety, including safety review, audit, and approval, as well as the application of safety-engineering principles throughout design, development, test, and operational phases of the system and its associated facilities and equipment. Consequently, this plan is concerned with both nuclear and nonnuclear hardware, manufacturing and assembly, handling and transport, ground test operations, space-vehicle launch, flight operations through ultimate disposal of the nuclear engine, and the effects of normal and abnormal flight operations on the world population. (auth)

28414 (TID/SNA-50) FEASIBILITY OF EARLY FULL FLOW PROPELLANT FEED SYSTEM TEST PROGRAM. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. Contract SNP-1. 32p. Dep. NTIS $4.75.

A detailed study of the feasibility of a proposed early test of the Full Flow Propellant Feed system has been carried out and it is recommended that the test not be performed. Analog computer systems have been developed to a high state of efficiency and upgraded by part experimental tests of reactors; the NERVA design equipment will not be ready for the proposed test which, can only be performed within a certain interval, so a parallel effort to develop equipment which will not be exactly representative of NERVA will be required (which will dilute and delay the main NERVA effort); and the information obtainable from the test is not that which is most needed. (LTN)

28415 (TID/SNA-51) 75K NERVA THERMAL AND FLUID FLOW ANALYSIS REPORT. (Aerojet Nuclear Systems Co.,

Sacramento, Calif. (USA)). Sep 1970. Contract SNP-1. 53p. Dep. NTIS $5.75.

Thermal analyses were conducted to establish pre-fire coast and steady-state full power thermal profiles for the case of continuous solar exposure at one Astronomical Unit with the engine axis normal to the incident solar radiation and an orientation about the roll axis such that the peak exposure occurs at a theta of 135°. The data are reported in terms of model station references which differ somewhat for the two phases of engine operation that were considered and also differ from the station references shown for the 1137400C Engine. It was assumed for these analyses that the thrust structures, gimbal assembly, and pressure vessel and closure were coated with aluminum oxide having an absorptivity of 0.38 and an emmitance of 0.69 because an earlier thermal analysis on an uncoated structure revealed excessive solar soak temperatures, resulting in the decision to assume the presence of the coating for further thermal analyses. The influence of solar exposure on temperatures of major components aft of the thrust-structure-pressure-vessel interface is negligible during full power operation. Thus the condition of the surfaces involved is of no consequence to these analyses and temperatures throughout the region are essentially uniform in the circumferential direction. (auth)

28416 (TID/SNA-52) S054-1008, S054-CP090290-F1: NUCLEAR ENGINE ASSEMBLY METHODS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 36p. Dep. NTIS $5.00.

Horizontal versus vertical methods of engine assembly were evaluated in support of engine design PDR. It was concluded that the NERVA engine shown in ANSC Dwg 1137400C can be safely, reliably, and economically assembled using techniques similar to those developed during the NRX and technology programs. NERVA engine assembly requirements and constraints were extracted from NPRD, Release No. 7, and Engine Specification CP 090290A, 8 September 1970. It was recommended that the engine be assembled in a vertical position using a floor-mounted support technique. The recommended sequence of assembly is shown. (auth)

28417 (TID/SNA-53) FILM COOLED METALLIC NOZZLE EXTENSION DESIGN STUDY, S054-DS301-W143f2i(2). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 70p. Dep. NTIS $6.50.

A design study is presented for development of a film cooled NERVA nozzle extension to serve as backup for the primary fibrous reinforced graphite composite nozzle extension. A suitability evaluation of two additional concepts for application in the NERVA engine in terms of engine performance is included. Material investigations and heat transfer and engine performance analyses necessary to develop a possible candidate are described. (auth)

28418 (TID/SNA-59) S130-CP090290AF1: NERVA ENGINE REFERENCE DATA. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 238p. Dep. NTIS $15.00.

The full-flow NERVA-engine is described and typical design and performance data are presented. The data are current to the date of document issue or of latest revision. Mission descriptions are to be considered reference missions for engine design purposes and not operational missions. The missions call for a reusable nuclear engine to be employed for the transfer of men or materials, or both, from earth orbit to lunar orbit and return, or to staging for deep-space injection and return. On the basis of these reference-mission requirements, a reference engine has been defined. The description and performance data are summarized. Additional subjects presented include operational considerations, programmatic data, engine requirements imposed upon the vehicle, program documentation, and tabulated engine performance and cooldown data computed by the flight engine program (FEP). (auth)

28419 (TID/SNA-61) 75K NERVA LOADS ANALYSIS REPORT. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 18 May 1967. Contract SNP-1. 462p. Dep. NTIS $26.25.

Two load conditions are presented for the primary structural components, (a) Launch Vehicle Operation static loads combined with preliminary dynamic loads for the two most critical time periods during launch with positive and negative vehicle side motions in six different lateral directions; and (b) preliminary static loads for the Nuclear Space Operation Full Power condition. Static and dynamic loads for the Launch Vehicle Operation condition represent specification extreme values. The components for which loads were obtained are shown and the load values are given. (auth)

28420 (TID/SNA-63) RADIATION EFFECTS ANALYSIS REPORT, TURBOPUMP CONFIGURATION DEFINITION AND MATERIAL SELECTION. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 80p. Dep. NTIS $7.00.

A radiation effects analysis was performed for the NERVA turbopump assembly which is identified in the NERVA Engine Specification Tree (Dwg 1137101, Figure 2) as EC90149 in the Propellant Feed Subsystem, EC 90218. The analysis includes: (1) component identification; (2) component location; (3) radiation environment and; (4) analysis of subassembly requirements and material properties. Nine materials in the subassemblies were analyzed to determine their capability to withstand the specific operating conditions of each subassembly. Each of the material properties is summarized with conclusions regarding the usage in the predicted NERVA environment. Problems that require further study (i.e., analysis or additional testing) are discussed. (auth)

28421 (TID/SNA-64) NERVA ENGINE/ETS-1 FACILITY COMPATIBILITY SAFETY STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 42p. Dep. NTIS $5.25.

An evaluation was made of the feasibility of safely conducting proposed engine test operations at Engine Test Stand No. 1 (ETS-1). Differences between the NERVA engine test series and previous NRX/XE test systems are compared for the purpose of uncovering new or greatly increased engine testing hazards relative to prior NRX/XE test analyses and experience. Potential safety problem areas are defined: hydrogen fire and/or explosion; inadvertent criticality; loss of engine coolant–emergency cooldown; fission product release–scrubbers; operating limits; and operating safeguards and personnel safety practices. (DLC)

28422 (TID/SNA-65) REQUIREMENT ALLOCATION SHEETS, S053-CP090205-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 412p. Dep. NTIS $23.75.

Results of a functional analysis performed on the NERVA 75 K flight engine and designated mission are presented in the form of requirement allocation sheets. (JWR)

28423 (TID/SNA-69) PROPOSAL FOR THE CONTINUATION OF AIR FORCE CONTRACT AP33(616)-3767 FOR A ONE YEAR PERIOD. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1957. 26p. Dep. NTIS $4.50.

Declassified 22 Nov 1968.

A revised proposal is presented which includes specifications, recommended work statements, and costs of: (1) chemical and nuclear rocket applications studies and comparisons, (2) nuclear rocket engine system studies, (3) facilities and testing procedure studies, (4) control systems development, and (5) experimental investigations. (DG)

28424 (TID/SNA-70) PROPOSAL COVERING THE REDIRECTION OF ACTIVITIES UNDER CONTRACT. Medved, A. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 23 May 1958. Contract AF 33(616)-5552. 6p. Dep. NTIS $4.00.

Declassified 16 Oct 1968.

28425 (TID/SNA-73) ROVER PROJECT: YEAR 1957. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 3p. Dep. NTIS $4.00.

Declassified 6 Nov 1968.

Nuclear propulsion research as of 1957 is discussed briefly. The major effort involved feasibility, evaluating preliminary designs of such equipment, and the beginning of computer simulations. The experimental study of the high temperature, structural properties of graphite was begun. Also, the development of temperature-sensing and control devices was initiated. (LTN)

28426 (TID/SNA-74) TECHNICAL DISCUSSION. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1958. Contract AF 33(616)-5552. 20p. Dep. NTIS $4.00.

Declassified 24 Sep 1969.

Space flight research proposals under study in 1958 are discussed in some detail–including a liquid hydrogen supply in space with its own refrigeration system and prototype nuclear engines. Satellite recovery problems are discussed in some detail. (LTN)

28427 (TID/SNA-81) ENGINE THROTTLING AND STARTUP AND SHUTDOWN MODES AND RAMPS, S-054-004, 005. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Oct 1969. 50p. Dep. NTIS $5.50.

This trade study evaluated: engine throttling requirements; criteria for high-chamber-temperature, low-chamber-pressure engine constraints; and criteria for startup and shutdown chamber-temperature and -pressure ramps. The advantages and disadvantages of throttling are listed; they vary with the mission requirements and the position of the throttle point. No problems are envisaged in reactor shutdown. High thrust start-ups give a small gain in payload on some missions, but involve more complexity and higher stresses and the high temperature ramp rates might affect reliability. (auth)

28428 (TID/SNA-82) NERVA ENGINE MATERIALS PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Dec 1969. 16p. Dep. NTIS $4.00.

The plan encompasses all phases of materials applications, ranging from conceptual design, component development, and hardware fabrication to the continuing feedback of information from operating experience and tests. The plan emphasizes a strong materials effort early in the design cycle to prevent development of materials problems. The approach of the plan is: To review all materials to assure reliable performance of components and the complete engine system on all missions; to provide materials properties data through the NERVA Materials Property Data Book (Report 2275) or through Data Release memoranda; to document all materials decisions, including those concerning applicability of materials for service, test results, and the review of design, specifications, and drawings; and to verify that the approval of drawings meets the requirements of established checkoff procedures (see Appendix A) and that stress calculations have been based upon valid properties data. (auth)

28429 (TID/SNA-83) RELIABILITY PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 1 Dec 1969. Contract SNP-1. 90p. Dep. NTIS $7.50.

This Reliability Program Plan was prepared to implement those portions of reliability methodology that will optimize available resources in developing a highly reliable NERVA engine system. The general approach presented is to perform detailed system-and-component-level failure-mode analyses, early in the systems analysis phase, to identify critical modes of failure; to implement a probabilistic approach to component design for these critical failure modes; to statistically design material and component testing; and to apply rigorous failure reporting, analysis, and corrective-action procedures during the development phase. The methods and plans developed apply to the analysis of the NERVA engine system as well as to each major subsystem and component within the engine. The approach presented is equally applicable to vehicle mission studies. (auth)

28430 (TID/SNA-87) RECOVERABLE NUCLEAR ROCKET FREIGHTER. Flagg, A. H.; McQueen, H. S.; White, L. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 23 Nov 1959. 2p. Dep. NTIS $4.00.

Declassified 8 Jan 1970.

It is visualized that the eventual use of nuclear rockets will be as hypersonic, recoverable, reentry vehicles. The conceptual design of the power plant involves a spherical main reactor (which minimizes pressure drop loads and gives an excellent structural support configuration) with an auxiliary reactor for heating the topping cycle working fluid. Shielding and coolant flow systems are mentioned and vehicle design is discussed briefly. The performance capabilities are presented and some problems, such as gamma radiation intensities, are introduced. (LTN)

28431 (TID/SNA-103) FEASIBILITY DEMONSTRATION OF A 90mm LH_2 HYDROSTATIC RADIAL BEARING FOR TURBOPUMP APPLICATION. Summary Report, December 1968 – November 1969. Roesch, E.; Accinelli, J. B. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 39p. Dep. NTIS $5.00.

The feasibility of a 90mm liquid hydrogen hydrostatic bearing was demonstrated. The test bearing envelope size was chosen to be representative of a possible near prototype size turbopump bearing and also to be adaptable for testing in a modified available ball and roller bearing tester. The tester bearing arrangement simulates that of a turbopump having a relatively short span between the bearings and an overhanging load, a condition inducive to shaft conical whirl. The test bearing calculations were based on an available analytical technique that assumes perfect parallel alignment between the journal and the bearing; therefore, the calculated performance really pertains to an ideal case. Since the bearing application in the tester is subjected to some degree of shaft angularity and misalignment, a deviation of performance from that predicted by analysis could be expected. While this condition does not allow direct correlation between experimental results and analytical prediction, this tester shaft angularity may, in fact, more closely simulate the actual typical turbopump case than the ideal aligned case assumed for the mathematical model. If hydrostatic bearing performance is sensitive to conical whirl, then this condition may as well be part of the feasibility demonstration. Operating with shaft angularity will provide experimental data which can be used to upgrade the analytical program so that it can properly predict bearing performance with angularity. During the course of this development program, six steady-state test runs were made, three at 12,000 rpm and three at 24,000 rpm. (auth)

28432 (TID/SNA-107) POISON WIRE REMOVAL AND INSERTION ON GROUND, OCTOBER 1969 THRU FEBRUARY 1970. Interim Trade Study Report. Latin, E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Mar 1970. 38p. Dep. NTIS $5.00.

Poison wires are inserted into the reactor core to guard against accidental criticality of the NERVA Engine. Poison wire withdrawal/reinsertion device concepts were reviewed and evaluated with respect to the feasibility of providing a means of removing and replacing poison wires. In order to evaluate the concepts, a cursory functional flow diagram was prepared. The function of the wires during transportation, engine assembly, engine acceptance testing, stage assembly and checkout, and vehicle launch pad operations was then analyzed. Three poison wire withdrawal/reinsertion concepts were suggested to perform these functions. The assumptions and requirements upon which this decision was based are described. Note that the poison wires may have to be inserted, removed for acceptance testing, then reinstalled. (auth)

28433 (TID/SNA-109) MASS PROPERTIES ANALYSIS REPORT, 75K NERVA ENGINE (1136390A). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 91p. Dep. NTIS $7.75.

The mass properties for the 75,000-lb-thrust NERVA engine, its subsystems, and components as of 19 December 1969 are described. The engine assembly is depicted by Aerojet-General Drawing 1136390, "A" change. The engine uses the full-flow principle to drive twin turbopumps. The nuclear subsystem is contained within an aluminum pressure vessel. A stainless-steel nozzle expands to an area ratio of 100 : 1 with an extension constructed of graphite reinforced with graphite fiber. Radiation shielding is provided in the engine weight for the external shield, which approximates man-rating for missions as presently defined. (auth)

28434 (TID/SNA-111) FRACTURE AND STRENGTH CHARACTERISTICS OF NERVA TURBOPUMP MATERIALS IN GASEOUS HYDROGEN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 89p. Dep. NTIS $7.50.

The notch tensile strength and fracture toughness characteristics of several NERVA turbopump (TPA) materials in pressurized pure gaseous hydrogen were investigated. The purpose of the investigation was to determine if these properties would be affected when exposed to specific NERVA TPA operating temperatures and pressures. Results verified notch tensile strength reduction of nickel-base alloy Inconel 718 as well as of Waspaloy, even at pressures as low as 500 psi. Less severe embrittlement was observed for Ti 5Al-2.5Sn ELI. No embrittlement was observed in A286. Fracture characteristics of alloy 718 and Ti 5Al-2.5Sn ELI were also affected, as shown in 10-hr sustained-load threshold stress intensity measurements. (auth)

28435 (TID/SNA-112) NERVA SAFETY PLAN, S-019. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 138p. Dep. NTIS $10.00.

This Safety Plan has been prepared to satisfy the basic safety requirements of Contract SNP-1, the specific safety requirements of the NERVA Program Requirements Document, the safety regulations established by the AEC and SNPO, and applicable policies as set forth by the Aerojet-General Corporation and Westinghouse Electric Corporation. The NERVA Safety Plan defines a total integrated approach to safety including safety review, audit, and approval, as well as the application of safety engineering principles throughout design, development, test and operational phases of the system and associated facilities and equipment. Consequently, this plan is concerned with both nuclear and nonnuclear hardware manufacturing and assembly, handling and transport, ground test operations, space vehicle launch, flight operations through ultimate disposal of the nuclear engine, and the effects of normal and abnormal flight operations on the world population. The plan applies to the prime contractor, major subcontractors, and test operations organizations of the contractor(s) conducting activities associated with design, development, construction, installation, test, and the use of the NERVA system, subsystems, support systems, and facilities under the provisions of Contract SNP-1. (auth)

28436 (TID/SNA-113) SUBCONTRACT NO. NP-4 UNDER PRIME CONTRACT NO. SNP-1 BETWEEN AEROJET-GENERAL CORPORATION AND EDGERTON, GERMESHAUSEN AND GRIER, INC., BOSTON, MASSACHUSETTS. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1961. 103p. Dep. NTIS $8.25.

The work program for producing engine control preliminary specifications for the first NERVA engine test is described. (JWR)

28437 (TID/SNA-114) NERVA EXTERNAL SHIELD COMPONENT DESIGN REPORT (INTERIM) NO. 8600R: 71-015. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 72p. Dep. NTIS $6.75.

The External Shield Requirements, Mechanical Design, Per-

formance, Nuclear Radiation Analysis, Thermal Analysis, Structural Analysis and Reliability and Safety Analysis for the current design maturity are presented. The External Shield concept consists basically of horizontal layers of borated graphite, lead and lithium hydride in that sequence with the borated graphite side towards the Pressure Vessel and Reactor Assembly. This group of shielding materials is enclosed and supported by a stainless steel structure consisting of two horizontal stainless steel plates joined by concentric cylindrical and conical sections. The horizontal plates serve a dual function both as shielding material and structural members. The cylindrical and conical sections serve only as structural elements. The lead serves as a gamma shield material and was chosen for its good attenuating properties and low cross section for secondary gamma production. The Borated Graphite is the initial neutron shielding material and was selected for its high temperature capability. The Lithium Hydride is a highly efficient light weight material which completes the neutron shielding for engine sources. In addition, its location essentially eliminates neutron-induced gamma radiation production in the shield due to back scatter of neutrons to the engine from the propellant tank LH_2 inventory. The External Shield is designed to attenuate the nuclear radiation from the NERVA engine to limit the maximum integral dose to 10 rem at the flight crew and passenger locations. The shield was designed for the NERVA engine operating in conjunction with a 33 foot diameter, 300,000 pound inventory LH_2 tank with a conical bottom of 15° half angle. The shield meets the special requirements of passive cooling and has provisions for remote removal and replacement in a vehicle in space. The selected configuration has an overall envelope 99 inches in diameter, 10 inches in height, including a 25 percent growth potential with an overall weight of 9765 pounds. (auth)

28438 (TID/SNA-116) WIRING HARNESS TRADE STUDY. S054-418. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 76p. Dep. NTIS $7.00.

A trade study was made to evaluate the mechanical considerations that the wiring harness will impose on the reference engine design. Use of previous experience involved plans to fabricate the wiring harness in modules, to attach the wiring by flame spraying (which provides attachment and a heat sink in a radiation environment), to use stainless steel sheath with MgO insulation and copper wire in high radiation areas, and to take special care at connections, etc. (LTN)

28439 (TID/SNA-117(Vol.2)) POST-SHUTDOWN OPERATIONS TRADE STUDY FOR NERVA HOT-BLEED ENGINE. Volume II. Houghton, W. J.; Kluger, P. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 143p. Dep. NTIS $10.25.

The use of auxiliary or main pumps for cooldown of the hot-bleed engine is not recommended. Cooldown systems driven with tank pressure are recommended for the NERVA engine. The ability to use liquid hydrogen appears to be a necessity, but the ability to use ullage gas for cooldown may give the vehicle a payload advantage (in Mission A of 2200 lb.). It is recommended, therefore, that the engine be designed to use either ullage gas or liquid for cooldown at the option of the mission planner. It is proposed that the control of shutdown and cooldown impulse be accomplished by varying the chamber temperature. This technique has, among other advantages, the capability of matching more closely a predicted profile of impulse versus time. Matching an impulse profile in rendezvous maneuvers may become a part of the NERVA program requirements document (NPRD) in the future. It is anticipated that thrust nulling during cooldown will be needed under some conditions of payload transfer, station keeping, and docking. The recommended concept for engine thrust nulling is to run the propellant through the engine and exhaust it to space through both the main nozzle and the auxiliary nozzles pointed 30° from forward centerline so that the net thrust cancels to zero (known as concept beta prime). Cooldown by radiators should be re-evaluated in the future because they show the smallest overall payload penalties for thrust nulling from 350 kw of engine heat to 10 kw. Auxiliary chemical propulsion may become a prospect as a thrust nulling concept if, among other things, nulling is only needed at low power (70 kw). (auth)

28440 (TID/SNA-119) SHUTTLE VEHICLE FOR STRATEGIC LUNAR OBSERVATORY (SR-183). McQueen, H. S. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Apr 1959. 2p. Dep. NTIS $4.00.

Declassified 3 Dec 1969.

Tentative conclusions of a lunar orbit feasibility study are that a nuclear-powered spacecraft is feasible and requires less propellant to be lifted from the earth to the initial 300 mile earth orbit than is required with the LO_2/LH_2 system. Vehicle weights, propellant weights, thrusts and specific impulses are given. (LTN)

28441 (TID/SNA-120) PROPELLANT FEED SYSTEM. S-054-012. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1969. 289p. Dep. NTIS $17.50.

The Propellant Feed System (PFS) draws low-pressure liquid hydrogen (LH_2) from the vehicle tank and delivers the LH_2 at high pressure to the reactor and nozzle. This trade study to select the PFS for the NERVA engine was performed in compliance with SNPO authorization. It compared a base PFS concept using one turbopump with combinations of turbopumps (TPA), boost pumps, valves, and lines. Multiple (i.e., redundant) components offer reliability improvements and provide other benefits to the engine system: i.e., provide emergency cool-down of the reactor and emergency partial power sufficient to achieve abort safety. The PFS chosen from many alternatives consists of: two turbopumps in parallel, swept-back centrifugal impellers, two spools to each turbopump with the inducer spool hot-gas driven; turbine feed system with two control valves, four block valves, and an intertie; and a turbine diluent line with no control valve. It was selected on the basis of its high relative reliability, high equivalent-specific-impulse, and the utilization of component concepts having demonstrated feasibility. (auth)

28442 (TID/SNA-121) NERVA CONTAMINATION AND CORROSION CONTROL PLAN S-021. Lamvermeyer, D. J.; Murchison, M. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1970. 84p. Dep. NTIS $7.25.

The purpose is to provide information and guidance that will help design engineers, quality-assurance engineers, fabrication engineers, materials and processes engineers, test engineers, and maintenance personnel to define criteria and areas of concern to prevent, control, identify, and treat various forms of contamination and corrosion in the NERVA engine system and associated ground-support equipment. The designer is given specific methods of controlling contamination in product design and a detailed listing of the factors affecting contamination in hardware. Comparisons of methods of cleaning and drying are presented. A listing of applicable cleaning specifications and standards is given. Methods of packaging and storage for maintenance of product cleanliness level are discussed. Corrosion control is presented from the view that control is best implemented through a thorough understanding of probable corrosion mechanisms and selection of materials, coatings, processes, and configuration control to mitigate probable corrosion mechanisms. Means of lessening these mechanisms are discussed as are test requirements for materials and processes. Quality-control requirements, corrective action, and corrosion-control preventive maintenance are outlined. (auth)

28443 (TID/SNA-128) FIFTH SEMIANNUAL PROGRESS REPORT. Fluidic Controls for the NERVA Engine. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 328p. Dep. NTIS $19.50.

This program was active from May 1968 through September 1970, a period of 29 months. During this period, the initial 17 months were concerned with the design and development of a fluidic chamber-pressure-control subsystem for the NERVA hot-bleed-cycle engine. Effort during the last 12 months was redirected toward all-fluidic power controls for the current full-flow engine. Both major power-control subsystems (i.e., chamber pressure and chamber temperature) were evaluated. The fluidic chamber-pressure-control subsystem was investigated for 12 months while the fluidic chamber-temperature-control subsystem was studied the last ten months. A "breadboard" design concept of the control subsystem was conceived and sufficient development work was accomplished on the major components to identify operational feasibility. A full-scale vortex throttle valve (30-in. diameter) was designed, fabricated, and tested over a range of engine operating conditions at actual fluid temperatures. A detailed vortex valve performance prediction analytical technique was programmed for existing digital computers and correlation of test results with theory was achieved. (auth)

28444 (TID/SNA-129) NERVA MATERIALS DEVELOPMENTS. Fourth Quarter, Contract Year 1970 (July, August, and September). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 352p. Dep. NTIS $20.75.

Topics include: (1) planning material test activities for CY 71 and beyond; (2) development of analysis techniques to adjust heterogeneous data; (3) determination of thermal conductivity for AISI 347 stainless steel and elastic moduli and Poisson's ratio for Inconel 718 and Ti 5 Al-2.5Sn (ELI); (4) embrittlement effects of 1400 psi gaseous hydrogen for alloy 718 and Ti 5Al-2.5Sn (ELI); (5) cryogenic radiation damage of Ti 5Al-2.5Sn (ELI); and (6) evaluation of prepreg, impregnation and fabric materials for optimum fibrous graphite properties. Component support topics include: (1) tensile design allowable development of Ti 5Al-2.5Sn (ELI) for turbopump applications; (2) evaluation of

fatigue, fracture toughness and stress corrosion properties of AA 7039-T63 for pressure vessel applications; (3) development of AISI 347 sheet tensile and creep properties for nozzle applications; (4) evaluation of orbital weld techniques for aluminum line fabrication; (5) selection of shield materials; (6) development of high load friction and wear properties of hard chrome/gold plate combinations; (7) revision of Contamination and Corrosion Control Plan; and (8) evaluation of weld processes for NASS duct coolant channel fabrication. (auth)

28445 (TID/SNA-135) ENGINE SYSTEM EVALUATION OF STRUCTURAL SUPPORT COOLANT SYSTEM. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 78p. Dep. NTIS $7.00.

The Structural Support Coolant System (SSCS) was evaluated to establish a reference design for engine PDR. The basic requirements of the SSCS are to provide sufficient coolant to prevent overheating of the stems (unfueled elements providing structural support for the core) and to provide controlled hydrogen flow for the reactivity control requirements of cold-to-hot criticality uncertainty, corrosion compensation, throttling, and reactor temperature control. An additional requirement of the SSCS is to provide bypass flow to cool the stem exit flow below the support plate temperature constraints. Fourteen concepts were generated and seven were evaluated in detail. The final selection was made on the basis of simplicity, reliability and safety. (auth)

28446 (TID/SNA-136) S054-022, S054-CP090290-F1: POST-SHUTDOWN OPERATIONS TRADE STUDY FOR THE FULL-FLOW ENGINE. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 229p. Dep. NTIS $14.50.

Studies on the cooldown of the full-flow NERVA engine following shutdown are reported. The studies covered cooldown method, cooldown controls, use of ullage gas in cooldown, and thrust nulling. (JWR)

28447 (TID/SNA-138) XE RADIATION ANALYSIS, s110-XE01-W118b1. Lindsey, B. A.; Courtney, J. C.; Hertelendy, N. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 210p. Dep. NTIS $13.50.

The radiation analysis and shielding aspects of the XE engine program are described. The analytical predictions are based primarily on Point Kernel analytical techniques coupled with discrete ordinates neutron transport techniques. A considerable portion of the report is addressed to the analysis of the radiation streaming in the many holes in the XE engine external engine shield. The influence of the ETS-1 engine test compartment on the radiation environment of the engine is reported in detail. The secondary gamma contributions from the ETS-1 facility shields were found to be much larger than facility shielding gamma ray scattering contributions. Some comparisons are made between these pretest predictions and test results. These comparisons show very good agreement between predictions and measurements near the pressure vessel and nozzle but under predictions in the vicinity of the external engine shield bottom. The streaming through the holes in the shield are close to predicted values. (auth)

28448 (TID/SNA-140) NERVA NOZZLE ASSEMBLY RADIATION ENVIRONMENT, s-100-TM-01-W118. Courtney, J. C.; Warman, E. A.; Roby, H. R.; Lindsey, B. A.; Wilcox, A. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 164p. Dep. NTIS $11.25.

The best Monte Carlo prediction of the radiation-induced heating in the NERVA nozzle assembly is given. For the stainless steel nozzle, the neutron contribution to heating is negligible. However, in the graphite nozzle extension, the neutron-induced heating is comparable to gamma heating. These results are in agreement with point kernel predictions within the limitations of the analytic techniques and mathematical models. Measurements taken during reactor and engine tests increase our confidence in these nominal levels. For subsequent thermal and stress analyses, the nominal heating rates in the nozzle were increased by 25% to 50% depending on the distance from the pressure vessel. (auth)

28449 (TID/SNA-142) NRTO SUPPLEMENTAL TO NERVA CONFIGURATION MANAGEMENT PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 30 Jun 1970. 38p. Dep. NTIS $5.00.

The plan of methods by which the company proposes to ensure that its documentation corresponds to parts actually made is described. The verification methods are defined and the procedure for changes developed (with change authorization responsibility defined and traceability provided for). Reviews and audits are provided for. (LTN)

28450 (TID/SNA-145) E-1 CAM REVISION 4. (Aerojet-General Corp., Sacramento, Calif. (USA)). 30 Apr 1970. 48p. Dep. NTIS $5.50.

The fourth revision of the E-1 Common Analog Model (CAM) consists of about 25 revisions to specific parts of the model. (LTN)

28451 (TID/SNA-146) SUPPLEMENT A70-C TO APPENDIX B. Statement of Work Covering 1 October 1969–30 September 1970. Revision. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 7 Jul 1970. 108p. Dep. NTIS $8.50.

28452 (TID/SNA-147) PNEUMATIC-ELECTRIC ACTUATION SUPPLY FOR NERVA HOT-BLEED ENGINE. S-054-018. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1970. 43p. Dep. NTIS $5.25.

A study of primary actuation power sources was initiated to ensure that NERVA design makes the maximum use of current technology to achieve low weight and high reliability. Although the XE engine used pneumatic gas controlled by small electrically-actuated valves, the high storage tank weight (1000-1500 lb), and problems of reliability and leakage losses in longer proposed flights, combined to create areas of concern. Further, electrical power supplies have become more attractive, while no significant gains in miniaturization have been made with pneumatic units. Three types of actuation supply systems were compared in detail (all-electric, all-pneumatic, and a hybrid) in terms of performance, weight, reliability, safety and experience. A hybrid system, incorporating pneumatically-actuated binary (i.e., on-off) actuators and electrically-actuated analog (i.e., variable position) actuators was selected for the following reasons: low weight (600 lb less than all pneumatic systems), safety and reliability potential, performance, and a reasonable combination of experience. (LTN)

28453 (TID/SNA-157) CONTRACT WORK STATEMENT. Supplement XXIV to Appendix B Dated February 1, 1968, Applicable to Modification No. 32. Work to be Performed During the Period October 1, 1967–September 30, 1968. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1968. 146p. Dep. NTIS $10.50.

28454 (TID/SNA-167) SUPPLEMENTAL AGREEMENT NO. 7, SUBCONTRACT NP-1 (UNDER PRIME CONTRACT SNP-1) BETWEEN AEROJET-GENERAL CORPORATION, SACRAMENTO, CALIFORNIA AND WESTINGHOUSE ELECTRIC CORPORATION, PITTSBURGH, PENNSYLVANIA. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 19p. Dep. NTIS $4.00.

28455 (TID/SNA-169) RELIABILITY AND QUALITY ASSURANCE INFORMAL PROGRESS LETTER NO. 46A FOR THIRD QUARTER, CY 1968 COVERING APRIL, MAY, AND JUNE 1968. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jul 1968. 23p. Dep. NTIS $4.25.

Progress is reported under the headings: (1) WANL surveillance, (2) reliability assurance, (3) quality engineering, (4) NRO quality assurance, and (5) NTO product assurance. (DG)

28456 (TID/SNA-170) ENVIRONMENTAL EVALUATION TESTING OF NERVA NRXA-2HF INSTRUMENTATION. Felter, M. G. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 15 Jan 1964. 87p. Dep. NTIS $7.50.

Engineering evaluation tests were conducted on candidate instrumentation for Nuclear Reactor Experimental A-2 Hot Flow (NRXA-2HF) tests. Tests included: temperature shock and acoustical for accelerometers, dynamic response and vibration sensitivity for LVDT and potentiometric pressure transducers, high temperature vibration for W/W-25% Re thermocouples, and cantilever beam strain tests for Microdot bonded strain gages. Servonics potentiometric pressure transducers must be isolated from vibration environment between 100 and 2000 cps. If they are shock mounted, a gamma heating problem is expected because of removal of the transducer from the heat sink. Both CCC and PSC LVDT type pressure transducers withstood vibration environment well beyond the needs of this program. All linear variable differential transducers tested need improvement of the translator system because carrier frequencies were induced on the output signals. Acoustical sensitivity of Clevite accelerometers will not jeopardize the data requirements of this program. Temperature shock (i.e., an instantaneous change from ambient to -300°F) produced a large voltage output of approximately 1450 mv peak to peak but the same temperature change over an interval of one minute produced only approximately 75 mv peak to peak. The AGC Tungsten/Tungsten 25% Rhenium thermocouples failed during vibration at 40 g input; one at ambient temperature and one at approximately 1500°F. The welded sensing junction opened up. Microdot bonded strain gages performed satisfactorily until the bonding agent, Rockide, partially or completely separated from the aluminum beam. The life and strength of the Rockide bond was extended by coating the bond with Versamid and curing at 140°F for two hours. Strain gages which were resistance welded to the beam performed satisfactorily. (auth)

28457 (TID/SNA-171) CONTRACT WORK STATEMENT. Supplement XXV to Appendix B. Work to be Performed During the Period October 1, 1967–September 30, 1968. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Aug 1968. 150p. Dep. NTIS $10.50.

28458 (TID/SNA-172) ANALYSIS OF THE ENGINE RESONANCE SURVEY IN THE LONGITUDINAL DIRECTION AT 3°–45' (SERIES II) OF THE VIBRATION SURVEY OF XECF IN ETS-1. Rosser, R. C.; Tow, D.; Jellison, J. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1968. 93p. Dep. NTIS $7.75.

A complete analysis of the engine longitudinal resonance survey test, test results, supporting dynamic analysis, and conclusions is presented. This was Part II (Series II) of the vibration survey of XECF conducted at ETS-1 in December 1967 and January 1968. Data acquisition was complete. All predominant engine resonant frequencies were determined. Engine mode shapes for the four lowest resonances were found. Mechanical impedances could not be determined due to the present lack of a computer program necessary for this operation. Damping characteristics for the complete engine were determined. The vibratory deflections of the engine, due to nuclear testing, were predicted and the stresses resulting from these deflections were calculated. A high margin of safety exists at all times. (auth)

28459 (TID/SNA-181) TIME LINE SHEETS. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 26p. Dep. NTIS $4.50.

Time line sheets are presented which specify the timing of various NERVA operational functions for a series of space missions. (DG)

28460 (TID/SNA-182) SCHEMATIC BLOCK DIAGRAMS. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 12p. Dep. NTIS $4.00.

Schematic block diagrams are presented for space missions, for assembly and checkout operations, for pre-launch operations, etc. (LTN)

28461 (TID/SNA-183) PREOPERATIONAL LOGISTICS SUPPORT PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 44p. Dep. NTIS $5.25.

28462 (TID/SNA-185) PRODUCT ASSURANCE PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 60p. Dep. NTIS $6.00.

28463 (TID/SNA-186) FUNCTIONAL FLOW DIAGRAMS. Preliminary. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 512p. Dep. NTIS $18.75.

Preliminary functional flow diagrams for a specified series of NERVA nuclear vehicle missions are presented. (DG)

28464 (TID/SNA-187) PERFORMANCE AND DESIGN REQUIREMENTS FOR THE NERVA PROGRAM SYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1968. 67p. Dep. NTIS $6.50.

The NERVA Program System (NPS) described consists of the NERVA engine system segment, the facilities system segment and the associated Aerospace Ground Equipment (AGE) system segment required to design, develop, procure, install, maintain, transport, repair and test the NERVA engine through qualification test of the engine at the Nuclear Rocket Development Station (NRDS). For planning purposes, the facilities and AGE to support the Delivered/Flight Engines beyond qualification test shall be included in assessing total system requirements. The engine shall be designed for a variety of missions requiring the high performance capability of nuclear propulsion. However, all applications require that the engine deliver a high Δv either; a) as an upper stage of a launch vehicle, or (b) when assembled in a multistage vehicle in earth orbit for planetary missions. The Aerojet-General Corporation is responsible for the continuing assessment of total system requirements for the missions specified herein in order to translate those mission requirements into NERVA Program System requirements. The inherently high performance of the NERVA Engine permits the consideration of missions not previously assessed in the national space program, including manned missions. (auth)

28465 (TID/SNA-188) NERVA SAFETY ENGINEERING PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 102p. Dep. NTIS $8.25.

This plan outlines the scope of the safety activities, defines the manner in which safety tasks are accomplished, describes the safety management structure in effect, identifies key responsibilities with respect to safety tasks and operational safety, and identifies safety documentation requirements. The plan has been prepared to satisfy the basic safety requirements of Contract SNP-1, the specific safety requirements of the NERVA Program Requirements Document as amplified by NASA Safety Manual NHB 1700.1, the safety regulations established by the AEC and SNPO, and applicable policies as set forth by the Aerojet-General Corporation. The issuance of this preliminary plan represents the completion of Event Block 14–Preliminary NERVA Safety Program Plan of the NERVA Management Plan and is intended to satisfy the requirements for a NERVA Safety Engineering Plan given in Section III. B. 8.c of the NERVA Program Requirements Document (PRD) (June 5, 1968). Safety is accomplished in the NERVA Program through line management responsibility with timely monitoring, surveillance, and support from appropriate levels of safety staffs. The actions and decisions which are required to achieve effective safety are virtually inseparable from program planning, management, and direction; the steps necessary to achieve safety begin with initial planning and extend through every facet of the program's activities. Under this concept, every line manager throughout the organization is responsible for identifying risks, hazards or unsafe situations or practices, and for taking steps to assure appropriate consideration is given to safety in all activities conducted under his cognizance. (auth)

28466 (TID/SNA-189) NERVA CONFIGURATION MANAGEMENT PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 82p. Dep. NTIS $7.25.

The Configuration Management Plan defined in this manual interprets the Air Force's AFSCM 375-1 manual for direct use on and application to the NERVA Program, for implementation by the Nuclear Rocket Operations (NRO) of the Aerojet-General Corporation. This manual establishes the procedures for configuration identification, configuration control and configuration accounting for the NERVA Program System, its System Segments, Contract End Items and Engineering Critical Components. The NERVA Program requirements are defined in the SNPO Program Requirements Document, SNPO-NPRD-1, and in the System and Contract End Item (CEI) Specifications (Part I). These documents specify the design and performance requirements which establish the criteria for the development of the detailed design disclosure documents (sub-specifications and drawings). The basic principle of managing requirements and design disclosure documentation is the control of changes to approved baselines and the proper invoking of all applicable documents, of a specific issue, to define a particular design configuration. This will be accomplished by first listing the design/performance requirement documents and then defining a configuration to meet these requirements by identification of all the design disclosure documents on a parts list document. This Configuration Management Plan encompasses three distinctive objectives: (1) configuration identification, which is the positive identification of the specific documents governing the requirements, and the design disclosure, process, test and inspection; (2) configuration control, which is the orderly introduction of approved changes to the established requirements or design configurations; and (3) configuration accounting, which is the recording of the actual, or as-built configurations. Configuration management may then be said to be the management of technical requirements and the design solutions to those requirements, and the changes thereto. (auth)

28467 (TID/SNA-210) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR PROPELLANT FEED SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 38p. Dep. NTIS $5.00.

28468 (TID/SNA-212) NERVA REQUIREMENTS ALLOCATION SHEETS, S053-SS090205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1968. 608p. Dep. NTIS $33.50.

Major changes in NERVA Systems Requirements are: additional facility requirements have been identified; certain engine parameters have been revised to agree with the latest available information; and the source document for various engine requirements has been identified. (auth)

28469 (TID/SNA–212) NERVA MANAGEMENT PLAN, M001-SS-09205-F1. Volume I. Management System. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 127p. Dep. NTIS $9.50.

28470 (TID/SNA-213) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR TURBINE BYPASS LINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

28471 (TID/SNA-215) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR COOLDOWN LINES. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 14p. Dep. NTIS $4.00.

28472 (TID/SNA-216) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR ENGINE PURGE UNIT. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 10p. Dep. NTIS $4.00.

28473 (TID/SNA-217) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR STAGE TANK PRESSURIZATION LINE AND CHECK VALVE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 10p. Dep. NTIS $4.00.

28474 (TID/SNA-218) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR TURBINE DISCHARGE CHECK VALVE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 12p. Dep. NTIS $4.00.

28475 (TID/SNA-219) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR COOLANT SUPPLY CHECK VALVE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

28476 (TID/SNA-220) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR COOLANT SUPPLY CONTROL VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 12p. Dep. NTIS $4.00.

28477 (TID/SNA-221) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR BY-PASS BLOCK VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

28478 (TID/SNA-222) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR PROPELLANT INLET LINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

28479 (TID/SNA-225) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR STRUCTURAL SUPPORT COOLANT VALVE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 15p. Dep. NTIS $4.00.

28480 (TID/SNA-235) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR ELECTRICAL POWER SOURCE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 7p. Dep. NTIS $4.00.

28481 (TID/SNA-238) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR TURBINE DISCHARGE LINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 14p. Dep. NTIS $4.00.

28482 (TID/SNA-246) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR ENGINE, NERVA, 75K, FULL FLOW. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 77p. Dep. NTIS $7.00.

This part of this specification establishes the requirements for the performance, design, test and qualification of equipment identified as the NERVA Nuclear Rocket Engine, Contract End Item (CEI) No. 90290. This CEI is used as a source of primary propulsive power for space vehicle applications to fulfill missions specified in Appendix B of the NERVA Program Requirements Document, SNPO-NPRD-1. This engine is a variable thrust, turbopump-fed, full flow cycle, nuclear-powered rocket engine utilizing hydrogen as the propellant, and designed to operate at a vacuum thrust level of 75,000 pounds and at a specific impulse of 823 seconds. This engine requires externally supplied liquid hydrogen and command signals. Many other detailed specifications are given. (auth)

28483 (TID/SNA-256) BUDGET ESTIMATE: 1972 NERVA DEVELOPMENT PROGRAM. Volume II. Narrative Descriptions by Project. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 193p. Dep. NTIS $12.75.

28484 (TID/SNA-257) FLUIDIC CHAMBER PRESSURE CONTROL SUBSYSTEM FOR THE NERVA ENGINE. Third Semiannual Progress Report. Carroll, J. J.; Boyd, D. D.; Felsing, G. W.; Lewellen, W. S.; Mockenhaupt, J. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 218p. Dep. NTIS $14.00.

The work reported relates to the design and development of fluidic controls for the hot-bleed-cycle engine. A basic flow schematic of the proposed fluidic subsystem for chamber-pressure control is shown. This preliminary design identifies the basic flow paths for the energy sources and sinks necessary to maintain fluidic control of the basic subsystem. This concept and the engine design state points (pressure and temperature) are the performance criteria on which the design and testing are based. Design and development of the initial subsystem components have progressed to the degree that subsystem integration and initial prototype flight-engine design could be formulated for the complete hot-bleed fluidic chamber-pressure-control subsystem. Redirection of the engine cycle to the full-flow system will require more subscale subsystem tests to redefine the flight-engine design requirements. All design concepts, analytical correlation techniques, and development experience will permit a redirection to the new engine cycle without serious delays to develop basic technology in critical areas. Design requirements should be resolved in time to keep pace with engine-system development provided adequate test facilities are made available for various component tests. (auth)

28485 (TID/SNA-258) NOZZLE ASSEMBLY TRADE STUDY. Shurley, L. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 109p. Dep. NTIS $8.50.

Four major aspects of the nozzle assembly are considered, each constituting a sub-trade study in itself. These sub-trade studies and the results of each are as follows: Determination of the nozzle-assembly terminal area ratio of 100:1; determination of nozzle-extension attachment point (attach the graphite extension to the cryogenically cooled portion of the assembly at an area ratio of 24:1); determination of location of the coolant inlet torus at the coolant inlet manifold so as to introduce the coolant into the subassembly at an area ratio of 24:1; and selection of primary nozzle as a one-piece cryogenically cooled nozzle. In addition to the above configuration-oriented major items subject to optimization, certain ancillary design parameters were considered. Such parameters do not affect the engine operation directly but do influence the nozzle functional characteristics, primarily with respect to reliability. (auth)

28486 (TID/SNA-259) ACTUATOR DRIVE POWER TRADE STUDY FOR THE FULL-FLOW ENGINE. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 21p. Dep. NTIS $4.25.

In the previous trade study it was ascertained that, for the hot-bleed engine, the completely electrically actuated valve concept afforded a significant weight saving and an increase in reliability over either the pneumatic system or the hybrid pneumatic and electrical system. The change to a full-flow engine cycle resulted in a need to reexamine the previous results to verify their validity for the new engine cycle. The details of the pneumatic-electrical trade offs were covered in Trade Study 018, and only those items applicable to the differences in the hot-bleed engine and the full-flow engine are covered in this report. Electrical actuator power was selected for the full-flow NERVA engine. (auth)

28487 (TID/SNA-262) s110-GTR20-W183: GTR-20A TESTS 37R010, 37R011, AND 37R013. Effect of Irradiation in LH_2 on Bearing Cages, Bearing Cage Materials, and Actuator Seals for NERVA Applications. Dewey, L.; Brown, D. A.; Carlson, G. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 41p. Dep. NTIS $10.25.

An irradiation of polybenzimidazole, polyimide and graphite in the GTR reactor was terminated after 459.5 MWh (45 percent of target) as a result of a leak. Both organics increased in strength, but polyimide reinforced with glass fabric lost strength (possibly due to the laminate, dimensions, or radiation degradation). Deleterious effects did not occur when these organics were reinforced with graphite. The materials are candidates for NERVA bearing cages and seals applications. (LTN)

28488 (TID/SNA-265) WATER DROPLET SIZE DETERMINATION FOR BREAK UP OF LARGE DIAMETER JETS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 138p. Dep. NTIS $10.00.

A series of nozzle tests in a wind tunnel has improved the understanding of how water from spray and penetration nozzles is distributed in a cross flow of gas, and how water-droplet sizes are generated. The drops generated by the break up of water jets from nozzles ranging in diameter from 0.25 to 1.5 in. were photographed in a series of wind-tunnel tests. (auth)

28489 (TID/SNA-280) EVALUATE TRADE-OFFS BETWEEN I_{sp} AND LIFETIME FOR A SPECIFIED FUEL ELEMENTS STATE-OF-THE-ART. (Aerojet-General Corp., Sacramento, Calif. (USA)). 19 Feb 1971. 54p. Dep. NTIS $5.75.

The objectives were to evaluate (1) the cost-effectiveness of trading exit gas temperature (or I_{sp}) for endurance (in the context of the number of lunar shuttle flights before engine replacement) and (2) the value of further increases in fuel element temperature and endurance capabilities. Plans changed and at that point the work was preserved without analysis of the computer calculations. It was also apparent that the results would be strongly affected by the policy and requirements of other organizations. (LTN)

28490 (TID/SNA-282) NUCLEAR ROCKET UNCOOLED NOZZLE STUDY PROGRAM. Phase I and II. Final Report. Schindler, R. C.; Dickson, J. C. (Aerojet Liquid Rocket Co., Sacramento, Calif. (USA)). 2 Jun 1971. 82p. Dep. NTIS $7.25.

The feasibility of utilizing an "uncooled" (radiation cooled)

nozzle in a long-duration nuclear rocket environment is determined in a two-phase study program. Nozzle designs are evaluated and candidate materials are characterized to ensure improved engine reliability and performance. It is determined that an uncooled nozzle fabricated of AGCarb-101 fibrous graphite composite material with a H_2 resistant barrier coating is feasible and offers potential for growth to higher temperatures and improved nozzle performance. (auth)

28491 (TID/SNA-285) MARS INTEGRATED EXPLORER MISSION. Vehicle Performance Analysis for a 1981 Mission to Mars. Hatcher, G.; Lavenda, T. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 179p. Dep. NTIS $12.00.

This study consisted of a series of analyses which define vehicle performance for the Integrated Mars Explorer Mission. For convenience, the study is divided in two parts. In the first, performance is evaluated in terms of payload delivered to Mars orbit in the Earth/Mars transfer phase of the mission. In the second, performance is evaluated in terms of useful payload delivered to Mars surface for the deorbit and landing phase of the mission. For the Mars transfer analyses, a computer program was developed which calculates vehicle performance and component weights based on impulsive velocity equations and simulated planar or bent conic transfers. Eleven vehicle configurations were evaluated in the Mars transfer analyses. The optimization of launch dates was shown to be an important factor in the comparison of vehicle performance for shorter transit times. The overall results of the Mars transfer analyses show that the superior performance of nuclear propulsion can be applied to provide desired combinations of improvements in larger payloads, faster transit times, or lower launch weights. The Mars deorbit and lander analyses were developed from a model and scaling laws derived from a Northrup Mars Surface Sample Return Study. The model uses an Aeroshell, ballute, and terminal propulsion system to deorbit and soft land a surface payload. Useful surface payload was found to be approximately 25% of initial lander weight. Lander payload performance varied inversely with initial weight and was relatively insensitive to terminal propulsion system performance characteristics. (auth)

28492 (TID/SNA-289) NERVA PROGRAM PROCEDURE. Failure Control System. Revision A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 27 Sep 1971. 5p. Dep. NTIS $4.00.

A system to insure that all test failures are recognized and resolved is described. (JWR)

28493 (TID/SNA-293) TURBOPUMP CONFIGURATION SELECTION, RELIABILITY AND PERFORMANCE. Campbell, W. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 17 Jun 1968. 110p. Dep. NTIS $8.50.

28494 (TID/SNA-306) PRELIMINARY ESTIMATE OF RADIATION ENVIRONMENT OF ENGINE COMPONENTS IN R-1 TEST IN TEST CELL C. Foreman, D. L. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. Contract SNP-1. 20p. Dep NTIS $4.00.

Preliminary estimates are provided for the radiation environment at non-nuclear engine components during full power ground test of the 75K engine in R-1 configuration at Test Cell "C". For the purposes of this report, the NRX-A6 configuration will be assumed relative to placing R-1 within the shields; i.e., the nozzle pressure vessel flange will be assumed to lie approximately 33 inches below the top of the Phoebus-IB shield. The assumption also is made that no nonnuclear engine components other than the nozzle, pressure vessel and associated hardware are to be tested during the R-1 test series. The kerma rate/heating rate numbers reported are based on extensive calculations of the flight environment for the 75K engine and past experience with experimental measurements during ground tests, and, as such, represent best engineering judgment of specification extreme numbers for use in thermal and stress analyses leading to engine P. D. R. (auth)

28495 (TID/SNA-307) PRELIMINARY ESTIMATE OF RADIATION ENVIRONMENT OF ENGINE COMPONENTS IN E-1 TEST IN ETS-1, S-100-TM-03-W118. Foreman, D. L. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 31p. Dep. NTIS $4.75.

Preliminary estimates of the radiation environment at nonnuclear engine components during full power ground test of the 75K engine in ETS-1 are reported. Assumptions made to permit analysis of this configuration are detailed to provide traceability for the data herein. The resulting kerma rates/heating rates are based on extensive calculations of the flight environment for the 75K engine and past experience with experimental measurements during ground test, and, as such, represent best engineering judgment of specification extreme numbers for use in thermal and stress analyses leading to engine P. D. R. (auth)

28496 (TID/SNA-308) NERVA TELEOPERATOR PROGRAM PROGRESS REPORT. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 147p. Dep. NTIS $10.50.

Manned and remotely controlled vehicles for space operations with the NERVA reactor are conceptualized, (subject to certain ground rules) including docking, space stations, maintenance, shield and/or engine replacement, etc. (LTN)

28497 (TID/SNA-310) STRUCTURAL ANALYSIS REPORT. Volume III. Thrust Structure Subsystem; Pressure Vessel and Closure Subsystem; External Shield Subsystem; Gimbal Assembly Subsystem. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 328p. Dep. NTIS $19.50.

The results of preliminary stress analysis on the thrust structure subsystem, pressure vessel and closure subsystem, external shield subsystem, and the gimbal assembly subsystem for the 75 K full flow NERVA engine are presented. (JWR)

28498 (TID/SNA-314) S054-201, S054-CP090290-F1: PRESSURIZATION GAS REQUIREMENTS. Carlson, G. A.; Hart, G. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 243p. Dep. NTIS $15.25.

Propellant tank pressurization requirements for startup, steady state operation, and shutdown of the NERVA engine are presented. (JWR)

28499 (TID/SNA-315) NERVA MAINTAINABILITY PROGRAM PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 53p. Dep. NTIS $5.75.

28500 (TID/SNA-316) NERVA VALVE/ACTUATOR CONCEPT SELECTION. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 456p. Dep. NTIS $26.00.

Concepts selected for NERVA Engine valves and data supporting those selections are reported. A "valve" is defined as a fluid control element that consists of a valve, an actuator that converts electric energy to mechanical energy, and a converter-controller amplifier that converts available power into a controlled form required by the valve. Detail design effort has been initiated on most of the valves selected during this trade study. The NERVA Engine requires numerous control elements to provide chamber pressure and temperature control during all phases of engine operation and to allow a single component failure without shutting down the engine. These control elements must be one to two orders of magnitude more reliable than typical Apollo type hardware, while operating in a Cryogenic hydrogen, high irradiation environment. (auth)

28501 (TID/SNA-319) S114-CP090290-F1: REFERENCE MISSION DATA BOOK FOR NERVA DESIGN. Volume I. Mission Data and Descriptions. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 172p. Dep. NTIS $11.75.

NERVA operating requirements and supporting data for reference missions, reusable vehicles, and trajectory analyses are presented. Reference missions call for a reusable nuclear engine to be: (1) employed for the transfer of men and/or materials from earth orbit to lunar orbit and return; and (2) used for injection staging of a deep-space probe and return of the stage to earth orbit. The primary objective has been to define the NERVA engine requirements necessary to perform flight operations for the reference missions and to provide a base case for determining engine design solutions resulting in payloads consistent with reliability, safety, and engine performance requirements. (auth)

28502 (TID/SNA-322) NERVA MANAGEMENT PLAN. Volume I. Management System. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 205p. Dep. NTIS $13.25.

28503 (TID/SNA-323) RELIABILITY PLAN, R101-SS090205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 63p. Dep. NTIS $6.25.

A reliability program plan for the NERVA space propulsion reactor system is presented. The scope of the program includes NERVA related hardware as well as the engine proper and includes population safety considerations as well as crew safety. The requirements set forth are applicable to all components, subsystems, systems, and facility which can affect the performance, operability, or safety of the NERVA related hardware. (auth)

28504 (TID/SNA-329) NERVA TRADE-STUDY REPORT, S054-CP090194-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Nov 1968. 175p. Dep. NTIS $11.75.

Trade study reports included are: (1) NERVA back pressure and tank pressure requirements for startup, (2) mode of cool-down effect on mission payload for the Manned Synchronous Orbit Ferry, (3) engine specific impulse, (4) estimated startup schedule for the 75K NERVA engine, (5) 75K NERVA engine performance maps, (6) preliminary evaluation of pump flow rate

during start transient of NERVA 75K engine, (7) 75K NERVA engine with structural coolant flow at 30, 10, and 5 lb/sec, (8) time hydrogen molecule spends in 75K NERVA engine at design power, (9) 75K NERVA engine actuator removal–replacement study, (10) 75K NERVA engine maintainability study, (11) 75K NERVA engine steady-state points, and (12) steady-state points for a 75K NERVA engine with various component configuration designs to attain a specific impulse of 825 seconds. (auth)

28505 (TID/SNA-330) QUALITY ASSURANCE INFORMAL PROGRESS LETTER 49A FOR SECOND QUARTER, CY 1969 COVERING JANUARY, FEBRUARY, AND MARCH 1969. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Apr 1969. 23p. Dep. NTIS $4.25.

Progress in quality assurance and quality engineering is reviewed. The effort was mostly in connection with the design and testing of components of the technology engine and of test facility modifications. (LTN)

28506 (TID/SNA-334(Bk.1)) COMPARISON OF THE FULL FLOW AND HOT BLEED ENGINES FOR NERVA APPLICATION. Book 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1969. 81p. Dep. NTIS $7.25.

The engine assembly drawings clearly indicate the simplifications possible in designing the turbine inlet and exhaust lines of the full flow engines. In addition to being cooler and shorter than those of the hot bleed engine, these lines are located forward of the pressure vessel closure. Thus, they are protected from radiation by both the internal and brim shielding of the engine. With regard to the nuclear subsystem, designs for either engine are feasible and the failure modes are comparable. Startup, steady-state operation and shutdown of the full flow engine have been verified by computer calculations. From the startup studies, it has been shown that the full flow engine will successfully start along a high specific impulse line. Furthermore, the engine bootstraps with a minimum preconditioning cycle, and turbine back pressures of from 0.5 to 12.7 psia appear to make very little difference on the engine startup. Excess energy has been shown to be available for full flow engine startup even when conservative values of design uncertainties are accounted for. No differences in shutdown of either full flow or hot bleed engine were noted. Consequently, it appears that meeting an 825 sec I_{sp} goal is more readily achievable with the full flow engine. This should allow more latitude in the resolution of development problems as they arise. From a reliability viewpoint, the full flow engine has been shown to have an inherently higher reliability than the hot bleed engine. Several reactor improvements and design changes have combined to make the full flow engine cycle superior in performance, reliability, safety and capability. (auth)

28507 (TID/SNA-335(Bk.1)) COMPARISON OF THE FULL FLOW AND HOT BLEED ENGINES FOR NERVA APPLICATION. Book 1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). May 1969. 80p. Dep. NTIS $7.00.

The engine assembly drawings clearly indicate the simplifications possible in designing the turbine inlet and exhaust lines of the full flow engines. In addition to being cooler and shorter than those of the hot bleed engine, these lines are located forward of the pressure vessel closure. Thus, they are protected from radiation by both the internal and brim shielding of the engine. With regard to the nuclear subsystem, the designs for either engine are feasible and the failure modes of the design are comparable. Startup, steady-state operation and shutdown of the full flow engine have been verified by computer calculations. From the startup studies, it has been shown that the full flow engine will successfully start along a high specific impulse line. Furthermore, the engine bootstraps with a minimum preconditioning cycle, and turbine back pressures of from 0.5 to 12.7 psia appear to make very little difference on the engine startup. No differences in shutdown of either full flow or hot bleed engine were noted. To achieve the same performance in the full flow engine as in the hot bleed, a reactor operating at a lower temperature is permissible. This reduction in reactor temperature is noted as a significant item as it might improve the reliability of the nuclear subsystem. From a reliability viewpoint, the full flow engine has been shown to have an inherently higher reliability than the hot bleed engine. The results of this study confirm results of previous studies and reinforces Aerojet's recommendation made in the full flow engine presentation of October 1968. That recommendation was, and still is, to convert the development of the nuclear rocket to the full flow engine for application to the NERVA Program. (auth)

28508 (TID/SNA-336(Issue2)) NASS EXHAUST DUCT SYSTEM DESIGN REQUIREMENTS. Issue 2. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1969. 41p. Dep. NTIS $5.25.

This document defines the performance and design requirements and the verification requirements of the Exhaust Duct System of the NERVA Altitude Simulation System (NASS) as installed in Engine Test Stand-1 (ETS-1) at the Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada. The relationship of this document to the ETS-1 Modification Program for the NERVA engine is described in F007-CP090219, "ETS-1 Design Criteria." (auth)

28509 (TID/SNA-339) NERVA FUNCTIONAL FLOW DIAGRAMS. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Dec 1968. 79p. Dep. NTIS $7.00.

28510 (TID/SNA-340) RELIABILITY AND QUALITY ASSURANCE INFORMAL PROGRESS LETTER No. 48A FOR FIRST QUARTER, CY 1969 COVERING OCTOBER, NOVEMBER, AND DECEMBER 1968. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jan 1969. 20p. Dep. NTIS $4.00.

The work effort was devoted primarily to XE-prime and backup engines, ETS-1 modifications, and to related component testing. A quality engineering work plan for the NERVA engine has been outlined to provide guidance for NERVA engine quality engineering. Specific attention will be directed towards awareness and knowledge of the design concepts and approaches and towards providing quality engineering comments and recommendations to contract end item and critical-component specifications. (auth)

28511 (TID/SNA-355) NERVA CONFIGURATION MANAGEMENT PLAN (SUPPLEMENT), C-018. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 40p. Dep. NTIS $5.00.

Specific management procedures to be used in the NERVA program are presented. (JWR)

28512 (TID/SNA-362) QUALITY ASSURANCE INFORMAL PROGRESS LETTER 51A FOR FOURTH QUARTER, CY 1969: COVERING JULY, AUGUST, AND SEPTEMBER 1969. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Oct 1969. Contract SNP-1. 19p. Dep. NTIS $4.00.

Quality assurance efforts on current problems involving bearings, turbopumps, valves, nozzles, etc. are reported. The efforts include computerizing information, evaluating inspection methods, evaluating welding methods, developing methods of detecting blocked coolant tubes, reviewing designs, establishing technician certification, bearing redesign, turbopump testing, writing valve assembly and testing procedures, evaluating dynamic balancing results, etc. (LTN)

28513 (TID/SNA-366) CONSIDERATIONS IN THE USE OF HYDROSTATIC RADIAL BEARINGS IN A LH_2 TURBOPUMP FOR NERVA APPLICATION. Roesch, E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 65p. Dep. NTIS $6.25.

A study was begun in the areas of (1) hydrostatic bearing requirements, (2) hydrostatic bearing concept design, and (3) accumulator system feasibility analysis. The requirements peculiar to the use of hydrostatic bearings in a prototype turbopump were explored. In the NERVA application, the transient modes of the operating cycle may extend as long as 30 minutes compared to seconds in a chemical engine. Since the transient duration per cycle, due primarily to the need to supply post-thrust reactor cooldown fluid, may be considerably longer than the steady-state operation, the bearing is required to operate at relatively unfavorable conditions most of the time. During the greater part of this time, the pump-supplied pressure may be insufficient for the bearing to provide satisfactory fluid film support of the rotor. Assuming that a satisfactory method will be found for rotor support during transient, conceptual design of a turbopump with hydrostatic radial bearings was initiated. The same hydraulic, aerodynamic, and general mechanical design was used as in the turbopump layout drawing No. 1118101, the reference (base case) turbopump originally designed for rotor support by 65 mm ball bearings. Within these envelope constraints, two 4 in. dia × 2 in. long hydrostatic radial bearings were substituted. For a pressure drop across the hydrostatic bearing, some redesign in the adjacent areas was necessary, adding a labyrinth, a buffer zone, and changing the impeller back face cavities. Load capacity, stiffness, and flowrates were determined for a range of pressure drop across the bearing from 100 to 1000 psi. For steady-state operation, the predicted bearing capacity of 1600 lb at 0.6 eccentricity ratio is encouraging. The throttling mode load capacity was calculated at 1000 lb. In the base case turbopump, axial thrust support is provided by a thrust balancer for steady-state operation and combined loading of the angular contact ball bearing during transients. When using hydrostatic radial bearings, the thrust balancer design will be retained for the steady-state axial thrust, but in addition to this, some means for transient thrust support must be added. Two possible means were suggested. A feasibility analysis was initiated to determine whether an accumulator could be a practical solution for feeding the hydrostatic bearings during transient operation.

The accumulator system initially envisioned became undesirable because of excessive weight and complexity, caused in part by the long duration transient requirements. (DLC)

28514 (TID/SNA-370) QUARTERLY PROGRESS REPORT FOR THIRD QUARTER CY 1970 COVERING THE PERIOD OF APRIL, MAY, AND JUNE 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 422p. Dep. NTIS $24.25.

Research progress is reported on nuclear rocket mission analysis and system analysis and engineering on NERVA engine projects. (JWR)

28515 (TID/SNA-371) NERVA MAINTAINABILITY PROGRAM PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. Contract SNP-1. 46p. Dep. NTIS $5.50.

The objectives of the NERVA maintainability programs are: To assure the most cost-effective maintenance possible within the requirements of the missions to be performed by the engine; to assure achievement of endurance and reliability goals in meeting the ten-hour life requirement of the engine; to provide a tool for extending engine life beyond ten hours; and to prevent excessive and unexpected down times of the engine. This program plan identifies and defines the tasks to be performed for the NERVA maintainability program. It describes the organizational relationships and responsibilities of maintainability and associated disciplines, outlines the scope of tasks to be conducted, identifies data items controlled and defines quantitative parameters to be used to measure achievement of goals. Maintainability activities are discussed in relation to six program phases: Preliminary design review, design and fabrication, development, engine assembly and testing, engine and stage development and testing, and flight-program maintainability activities. (auth)

28516 (TID/SNA-372) PRELIMINARY EVALUATION OF ENGINE TEST REQUIREMENTS (OPERABILITY REQUIREMENTS INPUT TO DATA ITEM F003). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. Contract SNP-1. 64p. Dep. NTIS $6.25.

Input to the NERVA Facilities Allocation Plan (F-003) establishes, on a preliminary basis, those tests necessary to verify engine operability requirements. The engine functional characteristics are reasonably well defined and most functional testing, with the exception of the "destruct" function testing, will be conducted at NRDS, therefore, evaluation is directed to the operability aspects of the engine level testing requirements. The test requirements have been established in accordance with the NERVA Engine Specification (CP-90290), dated 23 April 1970, updated 29 June 1970, and by examining other similar programs and evaluating their test philosophy, tests and results. The plan provides guidance for the application and allocation of all NERVA facilities ranging from engineering office buildings to manufacturing and test facilities. The CY-70 F-003 work has been limited to testing facilities. The work is further limited to the engine components, reactor (NSS), and NERVA engine test levels and provides, on a preliminary basis, the following; 1) a listing of the engine/NSS test requirements on a programmatic basis; 2) a listing of component/module test requirements; 3) identification of major facilities and/or major modification to existing facilities needed to support the NERVA component and engine testing program; 4) allocation of the testing requirements to existing or proposed facilities; 5) preliminary information necessary for development of F-004 requirements. (auth)

28517 (TID/SNA-377) FINAL REPORT OF SHIELD SYSTEM TRADE STUDY, S054-CP090290-F1. Volume I. Book 1. Warman, E. A.; Courtney, J. C.; Koebberling, K. O. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 61p. Dep. NTIS $6.25.

The NERVA flight engine shielding trade study is described. It encompasses both the manned mission and unmanned mission shielding studies. The substantive conclusions are that the optimum shielding configuration for a flight engine is a combination of a fixed internal shield (of approximately 3,000 lbs) with provision for incorporation of an uncooled external engine disk shield for manned missions, weighing up to 10,000 lbs for very light payloads. For heavy payloads, the requirement for a disk shield is replaced by indigenous attenuation of radiation in the payload. The internal shield shall be designed for minimum weight based on the unmanned mission requirements. The unmanned missions will not be penalized by any shielding associated with manned missions. The manned mission disk shield is flexible and can be designed to suit the payload or be replaced or removed in orbit, for a reusable nuclear shuttle. Biological shield weights were drastically reduced during the course of this study; principally due to: (1) the reduction in external engine sources, (2) the minimization of tank top dose by employing sharp conical propellant tank bottoms, and (3) the increase in the propellant tank capacity from 190,000 lbs to 300,000 lbs of LH_2. Analytical predictions of crew dose at the end of the study were close to those at the beginning with the major changes being due to deliberate changes associated with the above mentioned areas. There were no major changes in the results as a consequence of improvements in analytical methods and predictions. In fact, a sophisticated Monte Carlo analysis at the conclusion of the study verified the earlier, less sophisticated, Point Kernel analytical results. (auth)

28518 (TID/SNA-384) RADIATION ANALYSIS OF VARIOUS VEHICLES AND PAYLOADS FOR THE REUSEABLE NUCLEAR SHUTTLE, s100-TRA06-W118-12. Preeg, W. E.; Lindsey, B. A.; Loebberling, K. O. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 79p. Dep. NTIS $7.00.

Radiation shielding analyses were performed for the 75,000 lb thrust NERVA engine with various propellant tanks and for various payload configurations. The analyses included both Point Kernel techniques and coupled Discrete Ordinates/Monte Carlo techniques. The results of the more sophisticated Monte Carlo calculations confirmed previous Point Kernel trade studies that predicted that a 10,000 lb disk shield would be adequate for a typical light weight payload configuration with the reference 15° conical tank bottom configuration. The study of alternate tank configuration demonstrated that the disk shield weight could be reduced especially for configurations with a smaller tank bottom half angle. A dual tank "hybrid" configuration with an effective half cone angle of 10° required only a 4,500 lb shield as compared to a 10,000 lb basic 15° tank case. A 15° conical bottom tank with a 33 ft diameter cylindrical outer tank and a 10 ft diameter inner tank (or standpipe) was found to be ineffective in reducing shield weight requirements. A 7,600 lb disk shield was found to be required for a configuration of clustered 15 ft diameter tanks, with a voided region in the center of the hexagonally mounted upper tanks. Redesign to include a center tank would greatly reduce shield weight for this configuration. The results of the payload radiation analyses indicated that no disk shield would be required for a moderately heavy payload configuration. Very light payloads (< 10,000 lbs) were shown to have almost no payload indigenous radiation attenuation. A modified six-man Apollo command module payload required approximately a 10,000 lb disk shield at the engine to limit the crew dose to 10 REM per mission. (auth)

28519 (TID/SNA-385) FINAL XE-PRIME DOSIMETRY REPORT. Hertelendy, N. A.; Courtney, J. C. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 210p. Dep. NTIS $13.50.

The final results of the radiation measurements made during the XE-Prime engine tests are presented. Passive dosimetry was used to determine neutron and gamma intensities throughout the engine and the test stand during a series of development tests in Engine Test Stand No. 1 (ETS-1) at the Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada. The validity of the calculational model and the methods of analyses was determined by comparing the pretest analytic predictions with the actual results (Ref 1). About 2500 neutron and gamma dosimeters were distributed throughout the engine and test stand. Two special dosimetry runs, EP-1 (low power) and EP-1A (intermediate power), were scheduled. In addition, some dosimeters were left on the engine, on the facility, and in the area surrounding the test stand for the entire experimental program. Data accumulated over this period are designated as high-power dosimetry. Measured gamma KERMA and neutron fluences are presented for each of the low-, intermediate-, and high-power runs. Also, these integral data are scaled up to the gamma KERMA rates and neutron fluxes that would be expected during full-power operation (1120 Mw) of the XE engine. The exact locations for each packet of dosimeters for all the runs are given along with a brief description of the engine and facility. The gamma sensitive thermoluminescent dosimeters were read at the ANSC Dosimetry Laboratory at Sacramento, California. The activation foils were counted at the NERVA Test Operations (NTO) Counting Laboratory at NRDS. (auth)

28520 (TID/SNA-390) NERVA MANAGEMENT PLAN, M001-SS090205-F1. Volume III. Functional/Responsibility Matrix (Operational Disciplines). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 67p. Dep. NTIS $6.50.

This volume contains the operational discipline functional/responsibility matrix for the functions and output documents in the logic diagrams (Vol. II) of the NERVA management plan. This matrix identifies which operational discipline has the responsibility for execution of the functions and preparation of the output documents. (DLC)

28521 (TID/SNA-391) NERVA MANAGEMENT PLAN, M001-SS090205-F1. Volume IV. Functional/Responsibility

Matrix (Organizational Elements). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 69p. Dep. NTIS $6.50.

This volume contains the organizational functional/responsibility matrix for the functions and output documents in the logic diagrams (Vol. II) of the NERVA management plan. This matrix identifies which organizational element has the responsibility for execution of the functions and preparation of the output documents. (DLC)

28522 (TID/SNA-400) ENGINE TEST STAND NO. 1 (ETS-1) FACILITY REQUIREMENTS DOCUMENT, F004-CP090290-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1971. 91p. Dep. NTIS $7.75.

Facility requirements are presented which are necessary to support the NERVA program for the development and qualification engine test program. (DLC)

28523 (TID/SNA-402) MULTIPLEXER LOCATION STUDY, s054-DS420-W151f3g. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 86p. Dep. NTIS $7.50.

The advantages and disadvantages of four data acquisition system concepts for the NERVA engine are compared with regard to weight, reliability, interface complexity (engine-to-stage), system complexity, maintainability, and development costs and times. The dominant considerations are state-of-the-art (April 1970) radiation tolerances of building-block devices and circuits, the engine nuclear radiation environment, radiation shielding required to obtain high-reliability (aerospace, man-rated) performance, and potential cable weight savings. Conclusions are that the data acquisition electronics should not be located in the engine environment (below the propellant tank); however, the changing state-of-the-art in radiation hardened electronics could produce devices which would alter the study results. (auth)

28524 (TID/SNA-403) SYSTEM COST-EFFECTIVENESS MODEL REPORT, s001-SCE01-W119f8. Hart, G. D.; Manko Levite, R. H.; Nielsen, D. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1971. 226p. Dep. NTIS $14.50.

A description of the System Cost-Effectiveness Model developed during CY 1970 as part of Project 116 is presented. The work statement calls for the development of a "Prototype System Effectiveness Mathematical Model which can provide the framework for making cost effectiveness decisions of alternate engine configurations and program concepts." The approach, design, and formulation used in the current model are discussed. (auth)

28525 (TID/SNA-407) VIBRATION TEST DATA ANALYSIS OF H_2 COLD FLOW DEVELOPMENT TEST SYSTEM. Soo, P. P. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1966. 58p. Dep. NTIS $6.00.

Because the CFDTS test data displayed in the oscillograms were limited to the acceleration time-history of complex vibration wave forms, only a limited number of conclusions can be drawn as follows: Beat Phenomenon existed in the TPA unit and its associated structural components at turbopump speeds between 7,000 rpm and 15,000 rpm. The formation of beats occurs whenever a forced frequency is close to one of the natural frequencies of the structural system, or whenever two nearly equal frequencies are imposed on the system, regardless of what its natural frequencies may be. A pure resonant condition existed in the pump discharge line and the pump inlet line. A strong transient vibration existed near the nozzle manifold. No further information and conclusions can be obtained from these CFDTS oscillograms without further data reduction (in the form of spectral density, plot, etc) and further study on the basic structural vibration characteristics of the turbopump system. Recommendations are made for further study to determine the turbopump critical speeds, its natural modes of vibration and to identify the source of the vibrations. (auth)

28526 (TID/SNA-416) NERVA ENGINE NATURAL ENVIRONMENT REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). 5 Aug 1969. 89p. Dep. NTIS $7.50.

The natural environments to which the NERVA engine may be exposed are defined and environmental factors which might affect engine performance are evaluated. The environmental parameters to be considered in establishing engine design requirements are developed in quantitative terms by means of functional analysis. (JWR)

28527 (TID/SNA-428) ENGINEERING OPERATIONS REPORT: STRUCTURAL EVALUATION OF MARMAN V-BAND COUPLING AND FLANGE WITH CONOSEAL GASKET. Project 127-f; Paragraph 3. Oates, J. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1972. 50p. Dep. NTIS $5.50.

Preliminary results are reported for a development test program aimed at evaluating the structural capabilities of the Marman V-Band coupling and Conoseal gasket. The intended end use was for the 75K NERVA flight engine propellant lines. The program was terminated before completion with the results being inconclusive as to its suitability. The experimental results were complex and it was considered that design improvements might be made. Attempts were made to calculate the behavior of the assembly, but the model incorporated into the program did not satisfactorily reproduce the experimental behavior. The experiments are described in detail and analyzed to the extent possible. (LTN)

28528 (TID/SNA-432) QUARTERLY PROGRESS REPORT FOR SECOND QUARTER CY 1970. Covering the Period of January, February, and March 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 406p. Dep. NTIS $23.50.

Progress on the NERVA program and associated tasks during the quarter is reported. (JWR)

28529 (TID/SNA-433) ANSC SUPPLEMENT TO NERVA CONFIGURATION MANAGEMENT PLAN, S018-SS090205BF1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 30 Apr 1970. 47p. Dep. NTIS $5.50.

28530 (TID/SNA-437) ENGINE SYSTEM RATED PERFORMANCE TRADE STUDY, S054-CP090290-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 134p. Dep. NTIS $9.75.

Work performed in evaluating the performance of the NERVA reference engine is described. Engine state points throughout the engine were defined with two turbopumps operating normally at rated operating conditions and at 60% thrust and with one turbopump operating at the 80% thrust level. The reduced thrust level with one turbopump operating is based on the reflector-inlet-to-core-exit seal pressure differential not exceeding that at rated design conditions with two turbopumps operating. Parahydrogen properties based on the National Bureau of Standards generating codes were established as the best data for engine system analyses. Sensitivity of engine performance to component variations within a three sigma tolerance level was determined using the propagation-of-error analysis technique. Chamber pressure measurements were determined to be adequate for calculating and controlling engine thrust level at rated conditions of 75,000 ± 2,000 lbf. Chamber temperature measurements with a pump inlet flowmeter calibrated to 0.55% three sigma uncertainty for ground testing are required for calculating and controlling engine specific impulse of 825 sec ± 0.75% at rated chamber temperature of 4250°R. (auth)

28531 (TID/SNA-441) ANSC SUPPLEMENT TO NERVA CONFIGURATION MANAGEMENT PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 17 Jul 1970. 47p. Dep. NTIS $5.50.

28532 (TID/SNA-449) ENGINEERING OPERATIONS REPORT: NERVA PRESSURE VESSEL EVALUATION OF METHODS FOR MIDCYLINDER WALL TEMPERATURE CONTROL, e104-EPV01-W620f6. Tracy, D. W. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 15 Jul 1971. 57p. Dep. NTIS $6.00.

28533 (TID/SNA-475) NERVA OPERATING PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 40p. Dep. NTIS $5.00.

The Aerojet Nuclear Systems Co. internal management system for execution of the NERVA program is delineated. (JWR)

28534 (TID/SNA-483) ENGINE/COMPONENT DESIGN STATUS REVIEW. Phase II. Book I. Engine, Methods and Ongoing Components. Presentations to SNSO, Sacramento. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 320p. Dep. NTIS $19.00.

28535 (TID/SNA-487) SEMI-ANNUAL STATUS REVIEW. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1971. 284p. Dep. NTIS $17.25.

A review of the status of the NERVA program is presented. (JWR)

28536 (TID/SNA-503) ANSC MATERIAL PRESENTED IN SHIELDING MEETING AT SNSO; s100-PMS07-W118. Warman, E. A.; Woolson, W. A.; Pregg, W. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1971. 72p. Dep. NTIS $6.75.

28537 (TID/SNA-511) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Engine, NERVA, 75K, Full Flow. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 13 Jan 1971. 46p. Dep. NTIS $5.50.

Performance losses due to nozzle vibration and geometry imperfections were estimated for the NERVA (ϵ = 100 : 1) nozzle operating at the nominal chamber conditions of P_c = 450 psia and T_c = 4250°R. The results were used to upgrade the estimated derating factors presented in References (a) and (b). The derating factor due to nozzle vibration was estimated to be 0.05 percent. The maximum performance loss of geometric variations in the radial dimensions of +0.02 and −0.040 inches was computed to be 0.12 percent. A revised summary of performance losses and uncertainties for the 100 : 1 expansion ratio nozzle operating at nominal chamber conditions is given. Based on the revised derating factor, the nominal attainable specific impulse is 825.3 lbf-sec/lbm. The present estimate of the 3σ range (Reference (c)) in delivered specific impulse is between 820.6 and 830.1 lbf-sec/lbm due to the uncertainty of the analysis. (auth)

28538 (TID/SNA−517) MATERIALS PRIORITY AND MATURITY STATUS, s131-MPM07-W187. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 15 Feb 1971. 47p. Dep. NTIS $5.50.

The document gives the material test plan index and the recommended revised priority list for various NERVA materials. No actual property data are included. (DLC)

28539 (TID/SNA-533) 75K NERVA MASS PROPERTIES STATUS REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Oct 1969. Contract SNP-1. 21p. Dep. NTIS $4.25.

The mass properties data are listed for the 75K thrust level NERVA Reference Engine as of August 1969. This engine is depicted on AGC Drawing 1136339 N/C, which was released 23 July 1969. The total engine dry weight of 29,102 pounds includes all components that Aerojet-General Corporation is responsible for plus the Nuclear Subsystem provided by Westinghouse Astronuclear Laboratories. The engine features two turbopumps plus an auxiliary compressor, a pressure vessel constructed of 7039 aluminum, a Cres 347 U-tube nozzle, a 100 to 1 expansion ratio Cres 347 skirt, and a 50 inch diameter disk shield. Some systems and component designs are not finalized at this time; consequently, the weights given are not necessarily the estimated weights of a specific system or component, but an allowance made for it. (auth)

28540 (TID/SNA-538) EPIC ENVELOPE TRADE STUDY, S054-CP090290-F1, S054-417. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 35p. Dep. NTIS $4.75.

The objective of this trade study is to determine the cable weight savings which might be achieved by mounting EPIC on the engine vs on top of the tank. The EPIC should be placed at the tank top with an allocation of space at station zero for the potential mounting of a small electronic package. The tank top location for EPIC is selected since the location below the tank results in a severe weight penalty. This weight accrues from the shielding required to reduce the radiation environment for EPIC to a level which EPIC can be demonstrated to reliably withstand. A shield weight of 14,870 pounds (for an 8 ft^3 EPIC) versus a cable weight savings of 1,700 pounds resulted in a weight penalty of 13,170 pounds. The potential location of a smaller electronic package comprised of signal processing functions or actuator drivers at or near station zero can reduce the interface connection requirement at station zero. The increased reliability resulting from fewer connections must be compared to the weight penalty for shielding a smaller electronic package in this location, along with maintainability and engine packaging design considerations. (auth)

28541 (TID/SNA-540) WIRING HARNESS TRADE STUDY, S054-418, S054-CP-090290. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 73p. Dep. NTIS $6.75.

The purpose of Trade Study 418 is to determine the mechanical considerations that the wiring harness will impose on the reference engine and to incorporate these changes into the reference engine design. A summary of the conclusions reached is presented. (auth)

28542 (TID/SNA-555) QUARTERLY PROGRESS REPORT FOR THIRD QUARTER CY 1970 COVERING THE PERIOD OF APRIL, MAY, AND JUNE 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 421p. Dep. NTIS $24.25.

Nuclear rocket mission analyses and requirements are updated. System analysis, engineering, and integration studies on the NERVA engine are described. (JWR)

28543 (TID/SNA-562) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR LOWER THRUST STRUCTURE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 8p. Dep. NTIS $4.00.

Specifications are presented for the design, performance, testing, and qualification of the lower thrust structure for the NERVA 75K full-flow engine. (JWR)

28544 (TID/SNA-564) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR UPPER THRUST STRUCTURE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 8p. Dep. NTIS $4.00.

Specifications are presented for the design, performance, testing, and qualification of the upper thrust structure for the NERVA 75K full-flow engine. (JWR)

28545 (TID/SNA-566) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR TURBINE BYPASS LINE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 13p. Dep. NTIS $4.00.

Specifications are presented for the design, performance, testing, and qualification of the turbine bypass line for the NERVA 75K full-flow engine. (JWR)

28546 (TID/SNA-567) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR STRUCTURAL SUPPORT COOLANT LINES. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 13p. Dep. NTIS $4.00.

Specifications are presented for the design, performance, testing, and qualification of structural support coolant lines for the NERVA 75K full-flow engine. (JWR)

28547 (TID/SNA-568) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR ENGINE PURGE UNIT. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 10p. Dep. NTIS $4.00.

28548 (TID/SNA-569) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR STAGE TANK PRESSURIZATION LINE AND CHECK VALVE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 10p. Dep. NTIS $4.00.

28549 (TID/SNA-572) NERVA CONFIGURATION MANAGEMENT PLAN (SUPPLEMENT), C-018. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 42p. Dep. NTIS $5.25.

Configuration identification is the means of identifying the documents which define a given item or group of items, i.e., by number and revision letter. Customer approved specifications are the baseline-defining documents for establishment of configuration identification throughout the program. This identification is used in the preparation of the Controlled Assembly Parts List (CAPL), AGC's parts list document, which is the index to the controlling documentation for fabrication of the item and its components. Configuration control is the controlled method by which proposed changes to established configuration baselines are processed. The request for change is directed to the proper authority, prepared in accordance with contractual directives or publications, reviewed and approved as required. After approval, the change is implemented into the program. Configuration accounting encompasses the means for certifying that each end item reflects the approved baseline configuration and all authorized changes to the baseline. It documents the "as-built" configuration of the end item including test data, inspection data, waivers and deviations. One important role of configuration accounting is in the achievement of the First Article Configuration Inspection (FACI). (auth)

28550 (TID/SNA-573) SCHEMATIC BLOCK DIAGRAMS, S055-SS090205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 12p. Dep. NTIS $4.00.

Schematic block diagrams are presented for assembly, checkout and prelaunch operations involving the NERVA engine. (LTN)

28551 (TID/SNA-574) REQUIREMENT ALLOCATION SHEETS. Volume II. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 390p. Dep. NTIS $22.50.

28552 (TID/SNA-575) REQUIREMENT ALLOCATION SHEETS. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 333p. Dep. NTIS $19.75.

28553 (TID/SNA-577) NERVA MANAGEMENT PLAN. Volume III. Functional/Responsibility Matrix (Operational Disciplines). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 67p. Dep. NTIS $6.50.

This volume contains the complete operational discipline functional/responsibility matrix (FRM) for the functions and output documents delineated in the logic diagrams of the NERVA Management Plan. The purpose of this FRM is to identify which operational discipline has the responsibility for execution of the functions and preparation of the output documents. The "who" is categorized by 21 operational disciplines, in addition to Westinghouse Astronuclear Laboratory (WANL) and the Government. (auth)

28554 (TID/SNA-578) SUMMARY REPORT CY 1970. For Period Ending 30 September 1970. (Aerojet Nuclear Systems

Co., Sacramento, Calif. (USA)). Nov 1970. 537p. Dep. NTIS $30.00.

Activities in the Rover/NERVA program for the development of nuclear propulsion are summarized. (JWR)

28555 (TID/SNA-579) NERVA PRODUCT ASSURANCE PROGRAM PLAN. Revision A. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 1 Mar 1970. 90p. Dep. NTIS $7.50.

A management plan for ensuring quality assurance and reliability in the product, especially the NERVA engine, is developed. The plan involves the whole span of work from design, testing, acceptance, etc. and involves evaluating and reviewing designs, documentation and traceability of design changes, test results, corrective action, interface responsibility between cooperating organization, audits, etc. A planned procedure is outlined for most nonconformance or failure incidents that develop. (LTN)

28556 (TID/SNA-580) REFERENCE MISSION DATA BOOK FOR NERVA DESIGN. Volume I. Mission Data and Descriptions. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 172p. Dep. NTIS $11.75.

The Nuclear Engine for Rocket Vehicle Application–NERVA–operating requirements and supporting data for reference missions, reusable vehicles, and trajectory analyses are presented. Three reference missions call for a reusable nuclear engine to be: (1) employed for the transfer of men and/or materials from earth orbit to lunar orbit and return, Missions A-L-M and A-L-U. (2) Used for injection staging of a deep-space probe and return of the stage to earth orbit, Mission C. The primary objective has been to define the NERVA engine requirements necessary to perform flight operations for the reference missions and to provide a base case for determining engine design solutions resulting in payloads consistent with reliability, safety, and engine performance requirements. (auth)

28557 (TID/SNA-581) ENGINE ELECTRICAL POWER SOURCE, TRADE STUDY 419. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 24p. Dep. NTIS $4.25.

The feasibility of the NERVA engine generating its own electrical power through an alternator was investigated. The recommendation is that an alternator not be incorporated. The reasons are: The alternator provides no advantage over other sources; it poses a reliability penalty to the engine gas system; it poses a weight penalty; and it presents battery development problems. The power requirements, the assumptions involved and the analytical methods of comparison are given. (auth)

28558 (TID/SNA-582) NERVA THRUST CHAMBER ASSEMBLY STRUCTURAL DEVELOPMENT PROGRAM, 9443-63-3. Snyder, C. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 28 Jan 1963. 14p. Dep. NTIS $4.00.

The NERVA Thrust Chamber Assembly (TCA) consists of a number of components attached together mechanically. These components (the upper and lower thrust structures, the gimbal, the pressure vessel assembly and the nozzle assembly) will transmit vibration loads to each other in ways which are difficult to predict analytically. For this reason, an experimental evaluation of the vibration characteristics of the TCA is necessary. To this end the various TCA components will be assembled together with a dummy reactor and a dummy propellant feed system. These dummy components will consist of mass and interface mockups of actual components designed to simulate dynamic characteristics as closely as possible. This assembly will initially be subjected to a resonance survey to measure its fundamental frequencies and mode shapes. Following the evaluation of these vibration characteristics of the assembly, the best known vibration loads for the boost phase of flight will be applied at the RIFT interface of the upper thrust structure. This phase of testing will be conducted to determine the transmissibilities of the components for various forcing levels and frequencies and to evaluate the effect of these inputs on the components and their connecting joints. Another phase of this testing program will consist of evaluating the effect upon the assembly of shock loads expected during the boost phase of flight. These loads will be applied at the RIFT interface and data will be acquired to provide information on component shock transmission and shock levels. The experimental data obtained will be used primarily in the design analysis of components and their connecting joints, in correlation with analytical results, and in establishing reliability levels. Prior to testing the TCA, the thrust structure will be subjected to a resonance survey to obtain its vibration characteristics. The stiffness of this component has a great effect upon the behavior of the assembly when it is subjected to a vibration environment. For this reason it is important to obtain information for use in design efforts on the thrust structure prior to the testing of the assembly. (auth)

28559 (TID/SNA-585) FLIGHT SAFETY CONTINGENCY ANALYSIS REPORT, INITIAL DRAFT. Volume I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep. 1970. 280p. Dep. NTIS $17.00.

Flight safety analyses relative to the 75K NERVA engine as defined by flow diagram, Dwg. 1137401, Revision D, have been performed utilizing currently available design data, and are reported in this initial draft issue. The purpose of flight safety contingency analyses is to identify required analyses and perform required analyses to ensure in the event of mission abandonment the effects of modes of engine failure are minimized in a manner that optimizes system safety. These activities are done to enhance: mission success; crew and population safety; and to identify and assess contingency actions for mission recovery, mission abort and catastrophic accidents. Primary efforts are directed to the effects of single failures but multiple failures are also considered and analyzed. (auth)

28560 (TID/SNA-586) NERVA TEST PROGRAM PLAN, PRELIMINARY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 61p. Dep. NTIS $6.25.

The purpose of the NERVA Test Program Plan is to describe in a single document the test planning and implementation necessary to develop and qualify the NERVA Engine, its subsystems and components, and provide management visibility of the total test program to assure an integrated and coordinated approach. The NERVA Test Program Plan describes the test logic, interrelationships, constraints, general requirements, and test philosophy and specifies the minimum test planning, documentation, and report requirements for components, subsystems, and systems identified on the NERVA Engine Specification Tree. In addition, this document discusses the methods used to maintain traceability of test requirements from their source to final reporting and the means for providing feedback of test information to the appropriate design activity. The T-101 is basically descriptive in nature, providing visibility for test planning and implementation by extracting, presenting, and expanding upon pertinent information from the NERVA programmatic documents listed. The objective of this section is to collect in one place, the guidelines which in many cases have been developed independently to suit particular needs, integrate them into a consistent, logical set of guidelines, present them for use in subsequent planning activities, and establish a documented qualification philosophy. (auth)

28561 (TID/SNA-597) NRDS TEST CELL "A". NERVA Turbopump 65MM Bearing Testing. Supplemental Facility Design Criteria. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1971. 45p. Dep. NTIS $5.25.

Test Cell "A" facility, and special test equipment, requirements necessary to support the "Evaluation Testing of LH_2 Cooled 65mm Rolling Element Bearings for the NERVA Engine TPA," are based upon applicable test requirements delineated in the reference documents itemized. To allow testing in accordance with the most preferable schedule, two facility buildup and testing phases are considered: Phase I "Life Tests" which utilizes previous facilities to a maximum extent; and Phase II, "Transient Tests," which will be required after some minimum number of bearings have been life tested. (auth)

28562 (TID/SNA-599) NUCLEAR ROCKET UNCOOLED NOZZLE STUDY PROGRAM. Final Report. Phase I and II. Schindler, R. C.; Dickson, J. C. (Aerojet Liquid Rocket Co., Sacramento, Calif. (USA)). 2 Jun 1971. 82p. Dep. NTIS $7.25.

The feasibility of utilizing an "uncooled" (radiation cooled) nozzle in a long-duration nuclear rocket environment is determined in a two-phase study program. Nozzle designs are evaluated and candidate materials are characterized to ensure improved engine reliability and performance. It is determined that an uncooled nozzle fabricated of AGCarb-101 fibrous graphite composite material with a H_2 resistant barrier coating is feasible and offers potential for growth to higher temperatures and improved nozzle performance. (auth)

28563 (TID/SNA-606) PRESSURIZATION GAS REQUIREMENTS, TRADE STUDY REPORT. Carlson, G. A.; Hart, G. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 243p. Dep. NTIS $15.25.

The autogenous pressurization system offers higher reliability, increased safety, and lower weight, and is selected as the reference system. The recommended pressurization schedule for the NERVA engine is given. A 3.5 inch diameter bleed line located at the turbine discharge will provide sufficient pressurization gas to meet the engine NPSP requirements. The check valves in the pressurization line do not contribute to engine safety and should be eliminated from the engine flow schematic. The flow schematic should be modified to show an open line at the engine to stage interface. A performance advantage exists if the vehicle can start the mission with propellants loaded at low vapor pressure, i.e., 15 psia saturation. Preliminary analysis shows that the NERVA engine is capable of startup and autogenous pressurization of the tank from an initial saturation propellant condition of 15

psia. Further analysis is required to determine the effect of low tank pressure on the cooldown during zero-g periods when liquid flow may not be available. The tank pressurization controls should be designed to regulate the tank pressure level to satisfy minimum engine NPSP. This reduces the bleed flow rate and propellant venting losses. During the final burns of each mission, the user should be allowed an option to provide only the normal mode operation Net Positive Suction Pressure (NPSP) requirement because there is a performance gain resulting from reduced venting losses. The result of a prolonged pump chilldown causes an increase in the demand on pressurization gas during the start transient. Recirculation of chilldown propellant to the tank, if possible, would greatly reduce this demand. The pressurization requirements should be re-evaluated when concepts for pump chilldown are finalized. Use of a throttle hold to permit a greater time period for the tank pressurization to satisfy the NPSP requirement is possible, but is both undesirable and unnecessary. The option for utilization of ullage gas for engine cooldown after the last burn provides significant performance gains, and should be further investigated. (auth)

28564 (TID/SNA-607) NERVA OPERATING PLAN, m001-N0P06-W231f3. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 41p. Dep. NTIS $5.25.

The NERVA Operating Plan delineates the ANSC internal management system relative to the execution of the present NERVA Program two-year contract period. This plan is divided into four sections: A brief narrative describes the duties and responsibilities of each ANSC organization element, down through the section level. A matrix identifies the organizational responsibilities relative to the preparation, support and approval of the documents called for in the present negotiated work statement. Program directives, procedures and policy documents necessary to execute the NERVA Program are listed. The current ANSC organization chart is displayed. (auth)

28565 (TID/SNA-609) NERVA VERIFICATION PLAN, PRELIMINARY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 86p. Dep. NTIS $7.50.

The Verification Program for the NERVA Engine, Specification Item CP 90290, is written in accordance with the Data Item Description for T-102 Verification Plan, as approved by the ANSC Change Board and submitted to SNPO-C in March 1970. This Engine Verification Plan, which is directly responsive to Sections 3, 4 and 10 of the Engine Specification and the T-101 Test Program Plan, provides the test integration planning to coordinate the subsystem and engine verification plans. This T-102 also provides the engineering basis for developing the supporting implementation documentation necessary for the engine testing program. It provides initial planning for subsequent detailed planning and implementation of the development and verification requirements included in the Engine Specification (CP 90290) and as further defined in R-106 (Reliability and Flight Safety Test and Evaluation Plan). It also provides for the accommodation of subsystem verification requirements, when it has been determined advantageous by the aforementioned test integration planning. (auth)

28566 (TID/SNA-618) PRELIMINARY EVALUATION OF ENGINE TEST REQUIREMENTS, f003-pRT01-W113-05. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 65p. Dep. NTIS $6.25.

28567 (TID/SNA-622) ENGINE SYSTEM RATED PERFORMANCE TRADE STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 134p. Dep. NTIS $9.75.

Work performed in evaluating the performance of the NERVA reference engine described by Dwg. No. 1136390 is described Engine state points throughout the engine were defined with two turbopumps operating normally at rated operating conditions and at 60% thrust and with one turbopump operating at the 80% thrust level. The reduced thrust level with one turbopump operating is based on the reflector-inlet-to-core-exit seal pressure differential not exceeding that at rated design conditions with two turbopumps operating. Parahydrogen properties based on the National Bureau of Standards generating codes were established as the best data for engine system analyses. Sensitivity of engine performance to component variations within a three sigma tolerance level was determined using the propagation-of-error analysis technique. Chamber pressure measurements were determined to be adequate for calculating and controlling engine thrust level at rated conditions of 75,000 ± 2,000 lbf. Chamber temperature measurements with a pump inlet flowmeter calibrated to 0.55% three sigma uncertainty for ground testing are required for calculating and controlling engine specific impulse of 825 sec ± 0.75% at rated chamber temperature of 4250°R. (auth)

28568 (TID/SNA-632) NERVA ENGINE NATURAL ENVIRONMENT. Paavola, C. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 151p. Dep. NTIS $10.75.

An evaluation of all environmental factors which might affect operation of the NERVA engine is presented. The environmental parameters to be considered in establishing design requirements were determined by functional analysis. (JWR)

28569 (TID/SNA-635) ACTUATOR DRIVE POWER TRADE STUDY FOR THE FULL-FLOW ENGINE, S054-CP-090290-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 22p. Dep. NTIS $4.25.

After a new trade study comparison of electric and pneumatic actuation systems, electrical activator power was selected for the full-flow NERVA engine. The assumptions involved in the comparison are detailed. The decision was made on the basis of an estimated weight advantage (535 lb) and better reliability (0.9999 vs 0.99 on the basis of Apollo experience). It is considered that safe systems could be designed from either approach (or even a hybrid approach), but more experience has been acquired with electrical systems. (LTN)

28570 (TID/SNA-639) MAINTAINABILITY ALLOCATIONS, ASSESSMENTS, AND ANALYSIS, R201-CP090290-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 55p. Dep. NTIS $5.75.

The maintainability analysis of the NERVA engine identified by drawing 1137400C is presented in support of the preliminary design review. The analysis has been expanded beyond that normally covered to verify the current engine module selection and to include an evaluation of the capability of the current engine to satisfy specification requirements from the standpoint of maintainability. Engineering estimates were established for the maintenance time required for replacing and checking out each of the maintainable components and modules of the NERVA engine. Reliability predictions were obtained from information being prepared for Data Item R-202, Reliability Allocations, Assessments and Analysis Report. Maintainability parameter predictions were formulated using the analytical theory presented. The results of the analysis are summarized: the current design satisfies the specified maintainability requirements of the NERVA engine specification CP-090290. Where actual values have not been assigned to specification requirements, such as docking loads and maintenance time allocations, the engine is considered capable of meeting reasonable requirements. The modular grouping of the maintainable components on the current engine provides accessibility, and simple installation and removal movements for remote maintenance operations. Based upon reliability predictions, none of the modules contain components which would cause excessive module maintenance. Maintainability predictions based upon both current predicted reliability and allocated reliability indicate that it is unlikely that any specific maintainable component would fail during the engine life. NERVA Engine maintenance will consist of corrective maintenance where replacement of the maintainable components and modules will occur based on the condition of the item. A direct correlation does not exist between ground and space maintenance times and, until space equipment and facilities are defined, there will be no validity in space maintenance time estimates or maintainability parameter predictions. Consequently, additional analysis work in these areas will not be conducted until space operations are defined in sufficient detail. (auth)

28571 (TID/SNA-640) NERVA MAINTAINABILITY PROGRAM PLAN, R102-SS090205-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 52p. Dep. NTIS $5.75.

Maintainability is the probability that maintenance action will restore a system to specified operational conditions within a desired period of time when maintenance is performed at the specified level and echelon under specified environmental conditions and resources. As defined, maintainability is a capability designed into a system to permit servicing, repair, or replacement of parts when necessary, whereas maintenance is the physical action of performing the servicing, repair, or replacement on a system. The definitions indicate the involvement of maintainability in the early design and development of an item such as the NERVA engine to ensure that the necessary requirements are incorporated to permit timely maintenance to be performed. The cost factor in providing maintainability of a system is inherent in the definitions. Maintenance has time requirements, and the availability of specific resources, both of which represent cost. In addition, development costs to provide maintainability of a system must be considered. To ensure a cost effective maintenance program, trade-off must be made among in-place repair, component replacement, module replacement, replacement of engines and hardware throwaway levels. Number of personnel required, skill levels, maintenance equipment requirements, hardware acquisition cost, and other support requirements must be considered for each concept. The objectives of the NERVA maintainability program are: to assure the most cost-effective maintenance possible within the requirements of the missions to be performed; to pro-

vide input into the design such as the engine, NSS, and components; to monitor the development effort and iterative maintainability considerations as necessary; and to achieve system availability by preventing excessive and unexpected down time of the engine. (auth)

28572 (TID/SNA-641) NERVA MAINTAINABILITY PROGRAM PLAN, R102-SS090205-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 41p. Dep. NTIS $5.25.

Maintainability is a characteristic of design and installation which is expressed as the probability that an item will be retained in or restored to a specified condition within a given period of time when the maintenance is performed in accordance with prescribed procedures and resources. A major factor in establishing maintainability of a system is the cost element. Cost influences the degree of maintenance conducted such as in-place repair, removal and replacement of components, replacement of modules, replacement of engines, and hardware throwaway levels. Development and support costs must also be considered in selecting designs and maintenance concepts. The objectives of the NERVA maintainability programs are: To assure the most cost-effective maintenance possible within the requirements of the missions to be performed by the engine; to assure achievement of endurance and reliability goals in meeting the ten-hour life requirement of the engine; to provide a tool for extending engine life beyond ten hours; and prevent excessive and unexpected down times of the engine. The classic maintainability plans associated with maintenance of most products (i.e., airplanes and weapons systems), cannot be directly applied to the NERVA engine. In such programs the product has a very long operating life with emphasis on preventive maintenance and scheduled component replacement. Maintenance is manual and ground-based, whereas for NERVA the environment is space and the method includes remote handling. For military articles, availability or combat readiness factors are clearly defined and based on extensive experience; such data is presently not available for NERVA. Due to these differences and the reliability requirement of the NERVA engine, methodology is not presented in this plan. The methodology will be developed or selected as the program proceeds. (auth)

28573 (TID/SNA-643) NERVA MANAGEMENT PLAN, M-001. Volume III. Functional/Responsibility Matrix. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 105p. Dep. NTIS $8.25.

The complete functional/responsibility matrix (FRM) for the functions and output documents delineated in the logic diagrams of the NERVA Management Plan are defined. The purpose of the FRM is to identify who has the responsibility for execution of the functions and preparation of the output documents. The "who" is categorized by 23 operational disciplines, in addition to Westinghouse Astronuclear Laboratory (WANL) and the Government. (auth)

28574 (TID/SNA-645) ENGINEERING OPERATIONS REPORT: 75K NOZZLE/PRESSURE VESSEL JOINT INTERIM DESIGN EVALUATION REPORT. Project 141. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 31 Jan 1972. 269p. Dep. NTIS $16.50.

The necessity to explore the suitability of material candidates with structural capabilities comparable to Hastelloy-X, or greater, became evident when structural deficiencies were encountered while attempting to accommodate loads and the resulting stresses within the structural limitations of CRES 347. It was concluded: (1) The flat face nozzle to pressure vessel design concept, using Armco 22-13-5 as material of construction with design properties no higher than Hastelloy-X, is feasible. (2) The actual feasibility is greater than that reflected in Table I because of the deliberate conservatism applied to the analytical processes. Considerable weight savings could be realized by refining the design consistent with true Armco design properties and with unbiased design analytical processes. (auth)

28575 (TID/SNA-648) FINAL REPORT: PROPULSION/ELECTRICAL POWER GENERATION. Beveridge, J. H. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 155p. Dep. NTIS $10.75.

A study was made concerning the feasibility of using the NERVA rocket engine as a heat source for generating 25 kw of electrical power. An organic Rankine power-conversion system, with a hydrogen-filled primary loop and heat-rejection system, was selected in the study. The heat-rejection system utilizes the stage meteoroid shield as the radiating surface. The dual-mode feature provides a means to greatly increase the utilization of the NERVA engine as an energy source and permits increased operating flexibility. For planetary missions the capability of generating electrical power permits increased payloads. For short-duration missions (e.g., earth orbit to lunar orbit) the reduced duration of cooldown thrusting and the reduction of fluid requirements during cooldown are significant. (auth)

28576 (TID/SNA-649) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR ENGINE, NERVA, 75K, FULL FLOW. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 77p. Dep. NTIS $7.00.

This specification establishes the requirements for the performance, design, test and qualification of equipment identified as the NERVA Nuclear Rocket Engine, Contract End Item (CEI) No. 90290. This CEI, hereinafter referred to as the engine, is used as a source of primary propulsive power for space vehicle applications to fulfill missions specified in Appendix B of the NERVA Program Requirements Document, SNPO-NPRD-1. This engine is a variable thrust, turbopump-fed, full flow cycle, nuclear-powered rocket engine utilizing hydrogen as the propellant, and designed to operate at a vacuum thrust level of 75,000 pounds and at a specific impulse of 823 seconds. This engine requires externally supplied liquid hydrogen and command signals. (auth)

28577 (TID/SNA-652) FINAL REPORT, CY-1970. Shielding Code Improvements, Project 393. Lindstrom, D. G. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. 31p. Dep. NTIS $4.75.

Developments in improved shielding and radiation analysis computer codes are described. Work was carried out in three general areas: Code Coupling Improvements, biasing in Monte Carlo Calculations, and Monte Carlo Code Improvements. Each was an extension of efforts to provide ANSC and NERVA with an efficient system of computer codes for analysis of difficult radiation transport and shielding problems. Efforts in CY-1969 were directed primarily toward producing the basic methods for solving these problems. Work in CY-1970 was directed mainly toward giving these methods the flexibility and efficiency for precise and economical analysis of the problems. Comparisons have shown that the techniques give results comparable with those by other methods and, in most cases, at a fraction of the cost. (auth)

28578 (TID/SNA-656) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR COOLANT SUPPLY CONTROL VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 12p. Dep. NTIS $4.00.

Part I of two parts.

28579 (TID/SNA-664) QUARTERLY PROGRESS REPORT FOR FIRST QUARTER CY 1971 COVERING THE PERIOD OF OCTOBER, NOVEMBER, AND DECEMBER 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1971. 371p. Dep. NTIS $21.75.

Extensive fundamental research has been performed in investigating space materials, radiation effects, and the complex computer codes required to predict engine operation and behavior. The NERVA testing program has: 1. Demonstrated the ability of a reactor to operate for a period of 1 hr (NRX-A6). 2. Demonstrated the ability of a reactor/pressure vessel/nozzle assembly to attain a specific impulse of 825 sec (Pewee 1). 3. Demonstrated the ability of a reactor/pressure-vessel/nozzle assembly to develop a thrust of 75,000 lb (Phoebus 1B). 4. Demonstrated engine stability over a wide range of operating conditions (NRX/EST and XE-Prime), with start and restart capability both successfully demonstrated. 5. Demonstrated the successful performance (XE-Prime) of a hot-hydrogen-driven turbopump with liquid-hydrogen-lubricated bearings (8000 hp was developed at a liquid-hydrogen flow rate of 75 lb/sec). Progress is reviewed on a project basis. (auth)

28580 (TID/SNA-667) NERVA PROGRAM SYSTEM SPECIFICATION. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 67p. Dep. NTIS $6.50.

The NERVA Program System (NPS) consists of the NERVA engine system segment, the facilities system segment and the associated Aerospace Ground Equipment (AGE) system segment required to design, develop, procure, install, maintain, transport, repair and test the NERVA engine through qualification test of the engine at the Nuclear Rocket Development Station (NRDS). For planning purposes, the facilities and AGE to support the Delivered/Flight Engines beyond qualification test shall be included in assessing total system requirements from the Kennedy Space Center (KSC), Michoud Assembly Facility (MAF) and the Mississippi Test Facility (MTF), and translating these requirements to the requirements to be considered at the NERVA Program System level. The engine shall be designed for a variety of missions requiring the high performance capability of nuclear propulsion, but all applications require that the engine deliver a high Δv either: (a) as an upper stage of a launch vehicle, or (b) when assembled in a multistage vehicle in earth orbit for planetary missions. (auth)

28581 (TID/SNA-669) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR DESTRUCT SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 14p. Dep. NTIS $4.00.

Specifications are presented for the design, performance, testing, and qualification of the destruct subsystem for the NERVA engine. (JWR)

28582 (TID/SNA-670) NERVA ENGINE CEI SPECIFICATION. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Nov 1968. 92p. Dep. NTIS $7.75.

This part of this specification establishes the requirements for the performance, design, test and qualification of equipment identified as the NERVA Nuclear Rocket Engine, Contract End Item (CEI) No. 90194. This CEI, hereinafter referred to as the engine, is used as a source of primary propulsive power for space vehicle applications to fulfill missions specified in Appendix B of the NERVA Program Requirements Document, SNPO-NPRD-1. This engine is a variable thrust, turbopump-fed, hot-bleed cycle, nuclear powered rocket engine utilizing hydrogen as the propellant, and designed to operate at a vacuum thrust level of 75,000 pounds and at a specific impulse of 823 seconds with a contoured nozzle expansion ratio of 90:1. This CEI requires externally supplied liquid hydrogen, electrical power and command signals. (auth)

28583 (TID/SNA-676) TCR 9660-003: INJECTOR DEVELOPMENT TEST PLAN. Heinicke, D. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 21 Feb 1964. 35p. Dep. NTIS $4.75.

Plans are programmed for the development and testing of air injector for use in LO_2/LH_2 nozzle tests to determine whether the nozzle design is adequate for nuclear firing tests. (LTN)

28584 (TID/SNA-687) ENGINE THROTTLING, STARTUP AND SHUTDOWN RAMPS, AND CHILLDOWN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 54p. Dep. NTIS $5.75.

A trade study was performed to determine the criteria for engine optimum throttling, for high-temperature low-pressure engine constraints, and for startup and shutdown chamber temperature and pressure ramps. The study also investigated engine bootstrap and chilldown. The following design selections were made: The engine is to be capable of throttling to 270 psia (60% of thrust). Startup and shutdown will be accompanied on a line consistent with the throttled operating point. Nominal temperature ramp rate = 150°R/sec. Nominal pressure ramp rate = 50 psia/sec. Bootstrap requires in-line turbine control. Chilldown is required only to ensure proper pump operation. Flow control for startup throttling and shutdown was selected to be by means of the turbine in-line control valve (and throttling reactivity control by means of existing stem coolant and drum controls). (auth)

28585 (TID/SNA-689) NOZZLE ASSEMBLY TRADE STUDY, S054-CP090290-F1, S054-301. Shurley, L. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 109p. Dep. NTIS $8.50.

A trade study to select an optimum nozzle configuration, primarily with respect to payload and engine reliability, for the NERVA engine is described. (JWR)

28586 (TID/SNA-703) TEST SPECIFICATIONS FOR THE STATIC STRUCTURAL TEST OF THE NERVA TITANIUM PRESSURE VESSEL, S/N 001T. Hales, F. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 17 Jun 1963. 40p. Dep. NTIS $5.00.

The purpose of this test plan is to establish the specifications and procedures for the structural testing of the NERVA Titanium Pressure Vessel, in accordance with requirements outlined in the Structural Development Program Plan, No. 9548-62-2, Revision A, dated 20 November 1962. The four phases outlined will satisfy the objectives specified in the Development Program and serve as a basis for design improvement. Phase I will consist of a Limit Load Proof Test to demonstrate the ability of the pressure vessel and nozzle test simulator to withstand laboratory ambient proof pressure and to correlate these test results with design analysis. The Phase II Stresscoat Study will establish the location, direction, and intensity of principal strains in the pressure vessel under internal pressure loading. Phase III will conclude the pressure test portion of the program with a Limit Load and Deflection Survey. Phase IV will consist of an Axial Load test without internal pressure. This test will establish the integrity of the lower thrust structure to pressure vessel joint in tension and will conclude the test program. (auth)

28587 (TID/SNA-707) CHAMBER-PRESSURE-OPTIMIZATION TRADE STUDY FOR THE FULL-FLOW NERVA ENGINE, S054-CP090290-F1. Houghton, W. J. (ed.). (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1970. 104p. Dep. NTIS $8.25.

The objective of this trade study is to choose a chamber pressure for the NERVA full-flow engine. Chamber pressures over the range from 300 to 600 psia were studied. Engine thrust and chamber temperatures were kept fixed. Analysis included both normal operation with two turbopumps (TPA) and the malfunction mode of operation at full power with one TPA. Design limitations were found, and trade-offs were made between the differing development difficulties found at high and low chamber pressures. (auth)

28588 (TID/SNA-712) FILM COOLED METALLIC NOZZLE EXTENSION DESIGN STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 93p. Dep. NTIS $7.75.

Engineering analyses used in an attempt to develop a backup film cooled metallic nozzle extension are presented. The major survey and analysis conducted were literature survey, heat transfer study, and nozzle performance penalty study. The result, conclusion and recommendations are presented. (auth)

28589 (TID/SNA-714) NERVA PREOPERATIONAL LOGISTICS SUPPORT PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 42p. Dep. NTIS $5.25.

The policies, procedures, and responsibilities for providing integrated logistics support for the NERVA Propulsion and Test Systems Preoperational Program are established. The plan prescribes the maintenance management system, material provisioning methods, and material movement mode(s) necessary to provide minimum inventory during the various phases of the program. It applies to all NERVA Propulsion and Test System Programs, which occur during the NERVA Ground and Flight test phases. It applies to all Contractors to the extent delineated. Documentation required, or which is necessary for the Contractor to maintain adequate management control, may be prepared with Electrical Accounting Machines (EAM) or Electronic Data Processing Equipment (EDPE). (auth)

28590 (TID/SNA-716) 75K NERVA INTERNAL LOADS REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Nov 1969. 67p. Dep. NTIS $6.50.

Detailed results of internal loads analyses for each of the items in the NERVA Engine Segment Specification Tree are presented. These analyses determine the engine internal load distribution between components and therefore provide the structural design loads for engine and component design. The loads presented are the limit loads which act on the structure. No load factors or design margins are considered since they are applied in the stress analysis presented in S-36, "Structural Analysis Report." (auth)

28591 (TID/SNA-737) ENGINEERING OPERATIONS REPORT: DESIGN AND DEVELOPMENT OF LH_2 COOLED ROLLING ELEMENT RADIAL BEARINGS FOR THE NERVA ENGINE TURBOPUMP. Phase I. January 1969-December 1971. Project 121. Volume I. Accinelli, J. B.; Koch, D. A.; Duke, D. H. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 8 Feb 1972. 215p. Dep. NTIS $13.75.

A complete discussion is presented of the NERVA Engine LH_2 Turbopump Bearing Development Program conducted by the Turbopump Department, Engineering Operations of Aerojet Nuclear Systems Company, Sacramento, California under NASA Contract SNP-1. The general philosophy of bearing type selection, bearing design, materials, design analysis, the life-load-reliability relationships, failure modes, radiation effects, test methods and LH_2 test results are discussed. Results of LH_2 tests with 60MM duplexed angular contact bearings demonstrated feasibility for extended (greater than 10 hours) bearing life in this severe operating environment; however, LH_2 tests with a prototype 65MM duplexed angular contact ball bearing indicated problem areas and the need for considerable development effort. Bearing wear (balls and retainer) appears to be the dominant mode of failure with no clearcut evidence of fatigue type failures, even in tests of extended duration. A significant development effort is indicated in order to achieve the desired 10-hour life at the very high reliability requirement in the hostile LH_2 and radiation environment. (auth)

28592 (TID/SNA-741) FIBROUS REINFORCED GRAPHITE COMPOSITE SKIRT EXTENSION FOR THE NERVA ENGINE. Kotfila, R. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1969. 62p. Dep. NTIS $6.25.

The newly developed fibrous graphite products meet all of the primary material requirements. They are characterized by graphite fiber orientation in the direction desired to provide structural strength and stability and increase in strength from room temperature to the maximum service temperature of 2600°F, and because of the composite fibrous structure, thermal shock resistance is excellent. At 2600°F, attack by H_2 appears tolerable. The density of fibrous graphites is about 1.4 g/cc and therefore, radiation problems are less than for metallic structure. In addition, there does not appear to be a practical size limitation and

the skirt extension size can be fabricated with currently available equipment. (auth)

28593 (TID/SNA-750) THERMAL AND FLUID FLOW ANALYSIS REPORT FOR NERVA NOZZLE EXTENSION, s031-ENE02-W143f2d. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 130p. Dep. NTIS $9.50.

Temperature profiles have been computed for the reference AGCarb nozzle extension shell at full and partial powers. Twelve nozzle extension interface concepts have been thermally analyzed. The three-dimensional temperature distribution in a ribbed AGCarb extension has been computed. Scale model erosion tests of an AGCarb nozzle extension have been analyzed and applied to full scale erosion rate predictions. Candidate AGCarb nozzle extensions for erosion rate measurements on the Pewee nozzle have been thermally analyzed. Backup concepts for the NERVA nozzle extension have been analyzed. These include a film-cooled steel shell and an aluminum tubular structure which is both regeneratively cooled and film-cooled. (auth)

28594 (TID/SNA-753) CRITICAL SPEED ANALYSIS, NERVA TPA, MARK IV, ROTATING SYSTEM. Nelson, L. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Jul 1963. 34p. Dep. NTIS $4.75.

It is concluded that the calculated critical speed of the NERVA Turbopump Assembly, Mark IV, of 39,000 rpm represents an adequate margin above the design overspeed of 30100 rpm. However, the critical speed of the rotating system is sensitive to the rotor geometry, so it is recommended that the critical speeds of new designs be calculated as soon as feasible. Other problem areas are the impeller overhang and the turbine-shaft mode of coupling. (LTN)

28595 (TID/SNA-755) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Nozzle Assembly. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 68p. Dep. NTIS $6.50.

28596 (TID/SNA-759) RELIABILITY PROGRAM PLAN. Data Item Identification Number, R101-SS090205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 1 Dec 1969. 89p. Dep. NTIS $7.50.

This Reliability Program Plan was prepared to implement those portions of reliability methodology that will optimize available resources in developing a highly reliable NERVA engine system. The general approach presented is to perform detailed system-and-component-level failure-mode analyses, early in the systems analysis phase, to identify critical modes of failure; to implement a probabilistic approach to component design for these critical failure modes; to statistically design material and component testing; and to apply rigorous failure reporting, analysis, and corrective-action procedures during the development phase. The methods and plans developed apply to the analysis of the NERVA engine system as well as to each major subsystem and component within the engine. The approach presented is equally applicable to vehicle mission studies. (auth)

28597 (TID/SNA-769) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Engine, NERVA, 75K, Full Flow. Revision A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 13 Jan 1971. 45p. Dep. NTIS $5.25.

28598 (TID/SNA-771) NERVA FACILITIES ALLOCATION PLAN, F003-SS090205-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 39p. Dep. NTIS $5.00.

This plan interprets the SNPO-NPRD-1 document and Data Item T-101 and identifies all facilities (both existing and proposed) required to adequately support the engine program through engine qualification and acceptance testing of flight hardware. Specific functions are assigned to each facility available and to each facility planned or proposed for construction. This plan is the "top document" for the facility acquisition and planning program and provides the basic guidance to government agencies and NERVA contractors for the development of facility requirements. Those functional requirements considered potential candidates for reassignment are identified for further study by the organization responsible for facility design. The results of these studies will be incorporated into this plan as applicable. (auth)

28599 (TID/SNA-785) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR STRUCTURAL SUPPORT COOLANT VALVE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 14p. Dep. NTIS $4.00.

Part I of two parts.

Specifications are presented for the design, performance, testing, and qualification of the structural support coolant valve for the NERVA 75K full-flow engine. (JWR)

28600 (TID/SNA-786) PNEUMATIC-ELECTRIC ACTUATION SUPPLY FOR NERVA HOT-BLEED ENGINE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jan 1970. 43p. Dep. NTIS $5.25.

This study examined, primarily on a qualitative basis, three types of actuation supply systems (i.e., all-electric, all-pneumatic, and a hybrid) in terms of performance, weight, reliability, safety, and experience. Total and peak power requirements were computed for each system and compared to determine the system to be incorporated in the flight engine. A hybrid actuation system, incorporating pneumatically actuated binary (i.e., on-off) actuators and electrically actuated analog (i.e., variable position) actuators, was selected as the best actuation system. (auth)

28601 (TID/SNA-792) NERVA SOFTWARE AND COMPUTER EVALUATION STUDY. (Computer Sciences Corp., Los Angeles, Calif. (USA)). 1 Feb 1971. Contract N-004. 74p. Dep. NTIS $6.75.

For Aerojet Nuclear Systems Company, Sacramento, CA.

A study to determine the software requirements for the NERVA engine control development program and to select a computer family for control software development and engine control is reported. (JWR)

28602 (TID/SNA-811) REQUIREMENTS FOR DECEMBER 1971 TESTS ON ELECTRONICS IN THE GROUND TEST REACTOR: 28A011A PMOS POWER SWITCH, 28A011C PMOS ANALOG SWITCH, 28A011D JFET ANALOG SWITCH, 28A011E JFET MATCHED PAIR. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1971. 92p. Dep. NTIS $7.75.

The purpose is to establish the feasibility and circuit complexity bounds for cryogenic, radiation-hardened, p-channel, enhancement-mode, metal-oxide-semiconductor (PMOS) power switching devices in meeting NERVA valve actuator electronics requirements. This is one of a series of tests necessary to completely characterize the operation of PMOS power switches in the NERVA reactor radiation field. The mechanisms responsible for degradation of operating characteristics are complex. Both gamma cell and reactor tests under various temperatures, modes of device operation, and control conditions are required to quantify the effects of these mechanisms. The specific merit of the device for the intended actuator electronics application cannot be fully assessed until all testing has been completed. The extent of parametric degradation will serve to establish preliminary guidelines for ANSC circuit design utilizing hardened PMOS power switching devices. The extent and rate of radiation-induced damage in PMOS structures is a function of bias during irradiation. Consequently, the bias on the PMOS power switches will necessarily be fixed at various levels during irradiation to fully characterize the device. This precludes performing "in-test-cell" types of measurements during irradiation for most parameters, since bias levels must be changed in some predescribed manner to obtain parametric values. It will be necessary to perform irradiation in steps and accomplish data acquisition outside the test cell (or in a relatively low radiation environment) for the active-static discrete PMOS device tests. PMOS devices are inherently capable of improved operation at cryogenic temperatures. This fact makes operation of engine-mounted valve actuator electronics at cryogenic temperatures potentially attractive and is the basis for the requirement for the two tests in liquid nitrogen. (auth)

28603 (TID/SNA-816) TURBOPUMP ROTATING COMPONENTS RELIABILITY VERIFICATION PROGRAM PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 27p. Dep. NTIS $4.50.

Preliminary design analysis, conducted on the turbopump for the NERVA 75K full flow cycle, indicates that significant reductions (approximately a factor of 3.25) in bearing loads can be achieved by fabricating the rotating parts from titanium in lieu of A286 or 718. This is basically due to the difference in density of the materials and the resulting mass effect on the location of the first and second "stick mode" critical speeds. The lighter material with the selected rotor configuration has a "first critical" speed at approximately 36,000 rpm, while that of the heavier material has a "first critical" at approximately 27,000 rpm. As the operating range of the turbopump is from 0 to 30,000 rpm, the heavier material would have a "stick mode" critical in the operating range. Preliminary design and reliability analyses also indicate that the turbopump bearings are the most critical turbopump parts in meeting the 10 hour life requirements at the required turbopump reliability of .99978. Analysis also indicates that for the predicted bearing loads, with high-speed balancing and a titanium rotor, duplex ball bearings have a higher potential for achieving the required reliability allocation of .999999 for a single bearing. However, material data on 5A1-2.5 Sn (ELI) titanium alloy indicate that under certain environmental conditions,

in hydrogen, it may exhibit brittle characteristics which may prevent it from being a suitable rotor material. (auth)

28604 (TID/SNA-823) ENGINE THROTTLING AND STARTUP AND SHUTDOWN MODES AND RAMPS. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Oct 1969. 50p. Dep. NTIS $5.50.

NERVA trade studies are reported on the following: (1) engine throttling requirements; (2) criteria for high-chamber-temperature, low-chamber-pressure engine constraints; and (3) criteria for startup and shutdown chamber temperature and pressure ramps. (TWR)

28605 (TID/SNA-824) NERVA TELEOPERATOR PROGRAM. Progress Report. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 133p. Dep. NTIS $9.75.

28606 (TID/SNA-842) STRUCTURAL ANALYSIS REPORT, S036-CP090290-F1. Volume III. Thrust Structure Subsystem, Pressure Vessel and Closure Subsystem, External Shield Subsystem, Gimbal Assembly Subsystem. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 319p. Dep. NTIS $19.00.

The results of preliminary stress analyses of the thrust structure subsystem, pressure vessel and closure subsystem, external shield subsystem, and gimbal assembly subsystem for the NERVA 75K full-flow engine. (JWR)

28607 (TID/SNA-850) NERVA PROGRAM: SEMI-ANNUAL STATUS REVIEW. Presentation to SNSO, Sacramento, November 9, 10, 11, 1971. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 281p. Dep. NTIS $17.25.

28608 (TID/SNA-859) NRTO SUPPLEMENT TO NERVA CONFIGURATION MANAGEMENT PLAN, C-018, C018-SS090205BF1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 30 Jun 1970. 38p. Dep. NTIS $5.00.

Special problems in applying the NERVA Configuration management plan to test facilities are discussed. The process of identification at NRTO has a requirement not included in the basic definition given in NCMP. This requirement is the definition, for existing facilities, of what hardware and documentation should be "identified" as a matter of configuration management interest. In addition, NRTO must not only identify the configuration of interest, but must establish that the software matches the hardware through a verification process. This activity for new construction is clearly part of an accounting activity, but because the verification may also result in significant changes to the existing documentation, it must be included in the basic identification activity. The identification process for existing facilities is initiated by preparing a master document list, categorized within an identification matrix, which is described. The documents which will be incorporated as representing the Baseline will be primarily drawings and specifications. Documents such as procedures, standards, test data and engineering analyses may be included. (auth)

28609 (TID/SNA-866) SIMULATION OF COOLDOWN AND RESTART, VERSION II. Gordon, E.; Tejada-Flores, L. H.; Wheatley, E. A. Jr. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Sep 1962. 48p. Dep. NTIS $5.50.

A mathematical model has been developed to provide basic representation of the heat transfer and fluid flow in the NRX-A design with hot bleed. This representation provides the time dependent distribution of heat in the reactor during the cooldown mode of operation. Also, the time dependent variation of flow and pressure is determined. The time dependent rate of decay of total heat generation, Q_T, in each of the basic components or lumps of a given component was determined by digital computation for a power run by WANL. These Q_T's versus time are input functions to the model. The model provides logic to determine whether single (vapor) phase hydrogen or two phase hydrogen is present at the exit of each component flow path until single phase flow is assured. The convective heat transfer coefficient used in the final calculation for a given lump (either that for vapor phase or that for two phase flow) is dependent on the above logic. Also, the calculation of the fluid density is dependent upon the above logic. In addition, the representation of the friction coefficient in the pressure drop equation is dependent on the above logic. The representation of the nozzle coolant tubes has been increased in detail to consider conductive heat transfer from the hot side of the coolant tubes to the cold side and to consider the variation in rate of convective heat transfer to the fluid from the hot side versus the cold side. The model has conductive and radiative heat transfer paths which allow the variation in compenent temperatures to be considered when no fluid is flowing. This model can be used to determine the initial conditions for restart. The presently available six-delayed-group, space independent neutronics equations, power control loops, and turbopump representation can be included with the model to consider restart. The model in its present form is most applicable to the analog computer. However, with expansion of the number of lumps to represent each component and, thus, a more accurate determination of maximum temperatures within the component, the model will form the basis for a digital computer simulation. All constants and functions referred to in the model have been specified for the analog simulation. The analog model is being programmed. (auth)

28610 (TID/SNA-867) NERVA THRUST STRUCTURES. Interim Design Report N8600R:71-013. Bronner, H. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 58p. Dep. NTIS $6.00.

The concept design and analysis for thrust structures of the 75 K NERVA Full Flow Engine are described. The principle objective is to document the design results to date on the most promising concepts available for a specific engine design and to provide some insight for future design work on NERVA Engine Thrust Structures. The design analyses discussed include thermal, nuclear radiation, structural (loads, dynamics, stress), mechanical, and materials. In addition, Thrust Structure requirements, design descriptions, and reliability investigations are included. (auth)

28611 (TID/SNA-869) ENGINEERING DESIGN SHEET: DESIGN AND TEST REQUIREMENTS FOR NASS EXHAUST DUCT SYSTEM. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 49p. Dep. NTIS $5.50.

28612 (TID/SNA-873) ACCEPTANCE-TEST TRADE STUDY. Interim Report. Unger, R. I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. Contract SNP-1. 95p. Dep. NTIS $7.75.

A trade study to establish acceptance test criteria for the deliverable NERVA flight engine and to select the tests that provide a high degree of confidence for demonstrating that the acceptance criteria are met is described. (JWR)

28613 (TID/SNA-877) NERVA NOZZLE ASSEMBLY RADIATION ENVIRONMENT. Courtney, J. C.; Warman, E. A.; Roby, H. R.; Lindsey, B. A.; Wilcox, A. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 162p. Dep. NTIS $11.25.

Entensive calculations of the radiation environment of the NERVA nozzle assembly are discussed. Predictions for the radiation induced heating in the nozzle assembly are also presented. (JWR)

28614 (TID/SNA-878) NUCLEAR ENGINE ASSEMBLY METHODS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 36p.

Horizontal versus vertical methods of engine assembly were evaluated for the NERVA engine. The assembly methods were evaluated for the kinematic requirements imposed by each method as well as the facility, equipment, and personnel support requirements associated with each method. The safety, reliability, and cost associated with the various methods was also evaluated. These evaluations resulted in the recommendation that the engine be assembled in a vertical position using a floor-mounted support technique. The recommended sequence of assembly is shown. (auth)

28615 (TID/SNA-886) NERVA BEARING TESTER: USAGE AND TESTING SPECIFICATIONS. Duke, D. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). 5 Nov 1970. 219p. Dep. NTIS $14.00.

This specification establishes requirements and procedures for usage and testing of the NERVA electric motor driven bearing testers. (DLC)

28616 (TID/SNA-895) PROJECTS 228 AND 241 RECORDS PRESERVATION. Wayne, W. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 16 Apr 1971. 15p. Dep. NTIS $4.00.

(1) A preliminary analysis was made of a hydrogen recovery system to be used in turbopump testing and development. It was concluded (with some qualifications) that somewhere between 45 and 70 percent of the hydrogen could be recovered. Vendors' literature on possible equipment and costs was obtained. Records of the work to date were preserved. (2) Material collected during a safety study of Pewee 2 test operations was preserved. It is noted that XE-1 and Pewee 2 reactors were being stored with a high purge gas consumption and that certain safety procedures would have to be raised before more testing should take place. (3) Preliminary results of flight safety malfunction studies have been preserved and results to date summarized. (4) Reliability studies have been summarized and preserved. (LTN)

28617 (TID/SNA-924) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR ENGINE, NERVA, 75K,

FULL FLOW. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 77p. Dep. NTIS $7.00.
Part I of two parts.

28618 (TID/SNA-929) DETAIL SPECIFICATION: PART 1. Performance/Design and Qualification Requirements for Pump Discharge Valves and Actuators. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 23 Jun 1971. 108p. Dep. NTIS $8.50.

The Pump Discharge Control Valve (PDCV) assembly, EC-90280A, consists of a valve, an electro-mechanical actuation mechanism, and a controller amplifier, and is used in the Pump Discharge Control Module (PDCM) which consists of two parallel flow paths each containing a PDCV assembly and a Pump Discharge Block Valve (PDBV) assembly. During engine operation except cooldown, the PDCV assemblies control the flow of hydrogen through the pump discharge line in response to commands. During engine cooldown the PDCV assemblies are commanded open to allow the passage of hydrogen from the structural support coolant module through the PDCM and pump discharge line for nuclear subsystem reflector assembly cooling. Both PDCV assemblies actively control hydrogen flow during all transient engine operational modes as specified in CP-90290 and remain in a fixed position during engine steady-state operation. Each PDCV assembly is also capable of individually providing the required flow control in the event of a malfunction in the other PDCV flow path which requires that it be shut down. The performance of the PDCV assembly as installed in the PDCV shall be within the limits and under the conditions specified herein. The Pump Discharge Block Valve (PDBV) assembly, EC-90282A, consists of a valve, an electro-mechanical actuation mechanism, and a controller-amplifier, and is used in the Pump Discharge Control Module (PDCM) which consists of two parallel flow paths each containing a PDBV and a Pump Discharge Control Valve (PDCV) assembly. The PDBV assemblies remain open during all normal engine operating periods, including cooldown, and during all engine non-operating periods. Each PDBV assembly will close in response to a closing command signal in the event of a malfunction in the corresponding PDCV which requires shutdown of that leg of the PDCM. The performance of the PDBV as installed in the PDCM shall be within the limits and under the conditions specified herein. (auth)

28619 (TID/SNA-931) DETAIL SPECIFICATION: PART 1. Performance/Design and Qualification Requirements for Cooldown Supply Valves and Actuators. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 23 Jun 1971. 106p. Dep. NTIS $8.50.

The Cooldown Supply Control Valve (CSCV) assembly, EC-90258A, consists of a valve, an electro-mechanical actuation mechanism, and a controller-amplifier and is used in the cooldown module which consists of two parallel flow paths each containing a CSCV assembly and a Cooldown Shutoff Valve (CSOV) assembly. The CSCV shall be used to control propellant flow from the propellant tank during the cooldown period of all engine operational modes as specified in CP-90290. The CSCV assembly shall respond to an opening command signal to initiate engine cooldown and shall control flow in response to demand signals during the remainder of the cooldown period. The CSCV assembly shall respond to a closing command signal to block propellant flow at the end of the cooldown period. Each CSCV assembly shall be capable of individually providing the required flow control. The performance of the CSCV assembly as installed in the cooldown module shall be within the limits and under the conditions specified herein. The Cooldown Shutoff Valve (CSOV) assembly, EC-90276A, consists of a valve, an electro-mechanical actuation mechanism, and a controller-amplifier and is used in the cooldown module which consists of two parallel flow paths each containing a CSOV assembly and a Cooldown Supply Control Valve (CSCV) assembly. The CSOV assembly is used to block propellant flow from the propellant tank through the engine cooldown flow paths during all engine non-operating periods and during all engine operating periods except cooldown periods. The CSOV assembly shall respond to an opening command signal to initiate engine cooldown and shall remain open during the entire cooldown period. The CSOV assembly shall respond to a closing command signal to block propellant flow at the end of the cooldown period. Each CSOV assembly shall be capable of individually flowing the required amount of cooldown propellant. The performance of the CSOV assembly as installed in the cooldown module shall be within the limits and under the conditions specified herein. (auth)

28620 (TID/SNA-935) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Engine, NERVA, 75K, Full Flow. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 46p. Dep. NTIS $5.50.

28621 (TID/SNA-939) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Structural Support Coolant Valve. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 19 Nov 1970. 155p. Dep. NTIS $10.75.

28622 (TID/SNA-940) INFORMAL TRACEABILITY DOCUMENTATION. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 291p. Dep. NTIS $17.75.

Performance, design, and qualification requirements are presented for various components of the NERVA 75K engine. (JWR)

28623 (TID/SNA-947) PRELIMINARY VERIFICATION REQUIREMENTS (SECTION 4) FOR STRUCTURAL SUPPORT BLOCK VALVE (SSBV). Johnson, L. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 26 Feb 1971. 167p. Dep. NTIS $11.50.

Quality assurance requirements are presented for the structural support block valve assembly for the NERVA engine. (JWR)

28624 (TID/SNA-950) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Engine, NERVA, 75K, Full Flow. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1970. 122p. Dep. NTIS $9.25.

28625 (TID/SNA-971) ENGINEERING OPERATIONS REPORT: NERVA TURBOPUMP DESIGN REPORT. Project 121. (Aerojet-General Corp., Sacramento, Calif. (USA)). 24 Sep 1971. 214p. Dep. NTIS $13.75.

28626 (TID/SNA-979) ENGINEERING OPERATIONS REPORT: SHIELDING REQUIREMENTS FOR RNS NUCLEAR PROPULSION MODULE. Project 110, Work Statement Paragraph 7. Warman, E. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 14 Jul 1971. 15p. Dep. NTIS $4.00.

The first phase of evaluation of the radiation analysis and shielding requirements for a modular reusable nuclear shuttle (RNS) employing a propulsion module with the NERVA engine is described. (JWR)

28627 (TID/SNA-1013) TEST DESCRIPTION FOR NERVA LH_2 PUMP COMPONENT DEVELOPMENT TEST AT TEST CELL "C" (INDUCER TEST SERIES NO. 1). (Nuclear Rocket Test Operations, Jackass Flats, Nev. (USA)). 11 Nov 1971. 182p. Dep. NTIS $12.25.

The test program is to be performed at Test Cell "C" to support development of the NERVA LH_2 turbopump. This document presents the test setup and operational requirements for the first Inducer Test Series. (DLC)

28628 (TID/SNA-1017) CAST ALUMINUM ALLOY JACKET MATERIALS DEVELOPMENT PROGRAM FOR THE NERVA NOZZLE. First Summary Status Report for Period May–September 1962. Inouye, F. T. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Mar 1963. 151p. Dep. NTIS $10.75.

Gold, nickel, silver, copper, and eutectic 82% gold–18% nickel alloy were evaluated for primer application utilizing the "Static Melt Consolidation Process." Several of these primers were found to metallurgically react with cast A-356 aluminum alloy when the "Static Melt Consolidation Process" was employed. Gold appears to be most promising in the present study. Bonding inconsistencies were found to occur in several cases, indicating that further refinements in primer application are required. Metallurgical bonds evident in "as-cast" samples were fractured by T-6 heat-treatment quenching, which suggests the advisability of using the T-51 heat treatment or a self-aging cast aluminum alloy. A tube bundle submitted by Arthur Tickle Engineering Works Works, Brooklyn, New York was evaluated revealing the absence of a metallurgical bond between the tube bundle and cast aluminum alloy jacket. (90 fig.) (auth)

28629 (TID/SNA-1072) DETAIL SPECIFICATION: PART 1. PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR TURBINE BLOCK VALVE. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 25 Oct 1971. 334p. Dep. NTIS $19.75.

The TBV assembly consists of a valve, an electromechanical actuation mechanism, and an actuator driver; and is used in the turbopump assembly and valves module (TPA and valves module). There are two TPA and valves modules in the NERVA engine, each of which contains a TBV assembly installed in the turbine inlet line. The TBV assembly in the closed position blocks propellant flow in the turbine inlet line during all engine non-operating periods and during the cooldown period of engine operation. The TBV assembly responds to an opening command signal during the engine startup sequence and remains in the open position during engine startup, steady-state, and shutdown operation. During the

engine shutdown sequence, the TBV assembly responds to a closing command signal and remains in the closed position until commanded to open. In the event of a required shutdown of a TPA and valves module, the TBV assembly associated with the TPA and valves module requiring shutdown responds to a closing command signal to block propellant flow in the turbine inlet line and remains in the closed position until commanded to open. The performance of the TBV assembly as installed in the TPA and valves module shall be within the limits and under the conditions specified herein. (auth)

28630 (TID/SNA-1077) DETAIL SPECIFICATION: PART 1. PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR LOWER THRUST STRUCTURE. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 18 Jan 1972. 39p. Dep. NTIS $5.00.

The LTS is the structural member of the NERVA engine which transmits the total engine thrust load from the Pressure Vessel and Closure (PVC) to the Upper Thrust Structure (UTS). Engine thrust loads are transmitted to the UTS via LTS interfaces with the Gimbal Pivot (GP) Assembly and the Gimbal Actuator (GA) Assemblies. The LTS shall house and support the principal engine flow control modules and associated instrumentation and Control (I & C) System electronic components, and shall support the External Shield (ES). Performance of the LTS as installed in the NERVA engine shall be within the limits and under the conditions as specified herein. (auth)

28631 (TID/SNA-1102) NERVA EXTERNAL SHIELD COMPONENT DESIGN REPORT (INTERIM). Breindel, B. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 73p. Dep. NTIS $6.75.

28632 (TID/SNM-1) SECTION 4. QUALITY ASSURANCE PROVISIONS FOR ENGINE, NERVA, 75K, FULL FLOW. Preliminary. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 65p. Dep. NTIS $6.25.

28633 (TID/SNM-3) ENGINEERING OPERATIONS REPORT: PERFORMANCE OF A TWO-STAGE CENTRIFUGAL NERVA PUMP TESTED WITH AIR AS THE WORKING FLUID. Brunner, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 9 Dec 1971. 156p. Dep. NTIS $11.00.

Air test performance characteristics of the two stage centrifugal pump of the NERVA Engine are summarized. The 9 (nine) configurations tested included the initial design 2-piece second stage impeller. Presented are effects of inlet guide vanes, backvane size, impeller blade trailing edge shape, diffuser inlet vane angle and diffuser inlet throat area on overall performance, stage performance, and stall characteristics of the pump. (auth)

28634 (TID/SNW-3) NSS DATA ITEM OUTLINE REVIEW. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 31 Jul 1970. 251p. Dep. NTIS $15.75.

28635 (WANL-TME-1485) NR-1 REACTOR MECHANICAL DESIGN REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1966. Contract SNP-1. 133p.

Declassified 4 Sep 1973.

Presented is the latest concept of the NR-1 reactor along with a few alternate design approaches. This work is an extension of design studies completed since WANL-TME-1315, "NERVA II Reactor Conceptual Design Report." The major changes included in this report are designs for a flight shield beneath the support plate to save weight, a preliminary design for counterflow tie tubes sized to provide flow control of the reactor at the full power design point, and more detailed definition of each hardware component. Also included is a brief design oriented summary of the weight optimization study, flight safety evaluation, and component test program. (auth)

28636 (WANL-TNR-216) NRX/EST REACTOR TEST ANALYSIS REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1966. 582p. Dep. NTIS $32.25.

Declassified 4 Sep 1973.

Results are presented in chapters entitled: (1) performance analysis, (2) reflector thermal analysis, (3) core thermal analysis, (4) nuclear analysis, (5) dosimetry, (6) corrosion, and (7) post-operative radiochemistry. Reactivity calculations and flow and power calculation procedures are discussed in appendices. (DG)

28637 (Y-1399) AIR FLOW INSPECTION OF ROVER FUEL ELEMENTS. Blanks, J. R.; Wright, C. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). 11 Apr 1962. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

Declassified 30 Aug 1973.

Improvements were required in the precision of the air flow inspection system of Rover fuel elements. Two systems have been constructed which use strain gage pressure transducers to monitor the changes in static pressure caused by changes in hole diameters. One system uses a strip-chart recorder as a readout device and has a precision of ±0.0001 in.; a second system has a digital readout and card punch. This latter system has a precision of ±0.00007 in. and eliminates the recording of data by hand. (auth)

28638 (Y-DA-1907) VACUUM TREATMENT OF A FUEL ELEMENT. Fultz, C. R.; Johnson, R. W.; Napier, J. M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 5 Oct 1967. Contract W-7405-eng-26. 14p. Dep. NTIS $4.00.

Declassified 9 Aug 1974.

A screening experiment was performed in a vacuum chamber having a nominal pressure of 5×10^{-9} torr to determine the effect of high vacuum on fuel elements. Trace changes in the physical measurements of the elements were noted. The primary offgas during evacuation was mass (m/e) 28. (auth)

28639 GASEOUS-FUELLED NUCLEAR ROCKET ENGINE. Bettenhausen, L. H. Charlottesville, VA; Univ. of Virginia (1974). 220p. University Microfilms Order No. 75-4666.

Thesis (Ph. D.).

An energy exchange and nuclear reactor model for a gaseous-fuelled nuclear rocket engine is examined in detail. The model uses best available temperature-dependent thermophysical properties for energy exchange computations. Reactor computations use readily available reactor calculational codes and a well-known 16-energy-group cross-section set. The reactor computational method was extensively tested against available experimental data for gaseous-core reflector-moderated reactors before being used to calculate criticality and reactivity effects of the engine model. Appendices describe the thermophysical data used for uranium plasmas at temperatures from 5000 to 120,000°K at pressures up to 1000 atm., hydrogen from 30 to 100,000°K at 500 atm. pressure, and beryllia and porous ceramics in the temperature range 100 to 2500°K. Other appendices describe supporting calculations and derivations. Results of the study include temperature, neutron flux, and fission density radial profiles and a comparison of computed and available reactivity coefficients for the model engine. The results of the study were disappointing in that great difficulty in removing the enormous heat loads of a 20,000 MW reactor was apparent in the analysis, but the mathematical model became unstable in the most interesting range of propellant (coolant) flow rates. On the basis of the model used, it does not appear feasible to design a regeneratively-cooled, gaseous-fuelled nuclear rocket engine to operate at a power level as high as 20,000 MW and meet realistic conditions of temperature, pressure, and critical mass of fissioning fuel. (Diss. Abstr. Int., B)

28640 SUBMARINE NUCLEAR REACTOR. Devin, B.; Dupuy, G.; Schwartz, J. P. (to Commissariat a l'Energie Atomique). US Patent 3,840,431. 8 Oct 1974. Filed date 3 Apr 1972. 8p.

The submarine reactor comprises a core made up of fuel elements, elements for the control of reactivity, and stacks of thermionic diodes in which each stack is surrounded by an inert gas envelope and the emitter of each diode contains fissile material. The reactor core is placed within a single cooling circuit surrounded by a biological shield casing which is provided with means for automatic temperature regulation and for balancing the pressure of coolant fluid contained therein with the pressure of the surrounding seawater. (Official Gazette)

28641 MARINE PROPULSION. Aubry, Y.; Baujat, J.; Havard, J. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Fr. Energ.; 25: No. 265 (Special issue), 173-185(Aug 1974). (In French and English).

Solutions to problems involving safety and economical use of nuclear propulsion are shown to exist, thereby justifying the application of nuclear power to propulsion of merchant ships. A list of the nuclear ships currently in operation is given. French prospects in the field are examined. (FR)

Reactor Safety and Environmental Aspects

Refer also to abstracts 25764, 25797, 28817, 28822, 28845, 28870, and 28874.

28642 (AED-CONF-74-538-023) WELDING AND REACTOR SAFETY: REQUIREMENTS TO BE MET BY THE WELDING TECHNIQUES, AS SEEN FROM THE REACTOR SAFETY POINT OF VIEW. Kellermann, O. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). 1974. 17p. (In German). INIS.

From 2nd international colloquium: welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

Experience has shown that in some cases, the quality of welded joints has not been such as to fulfill the extreme safety requirements in present-day reactor technology. The faults and defects detected have had considerable consequences with regard to availability and costs, although they never entailed any immediate hazards to plant personnel or the environment. Only in a few of the cases reviewed has it been necessary to use the safety systems of the reactors concerned, and in all such cases these systems have been functioning as expected. (GE)

28643 (ANL-75-8) ONE-COMPONENT TWO-PHASE CRITICAL FLOW: AN EXPERIMENTAL STUDY USING FREON-11 AT SUBATMOSPHERIC PRESSURES. Howard, P. A. (Argonne National Lab., Ill. (USA)). Jan 1975. Contract W-31-109-eng-38. 74p. Dep. NTIS $5.45.

Low-pressure, one-component, two-phase critical-flow studies in long cylindrical tubes were undertaken using Freon-11. A stainless steel test section, equipped with numerous pressure transducers and thermocouples, was used to obtain experimental pressure and temperature profiles. Critical discharge pressures from 3.0 to 13.5 psia were observed with measured mass fluxes from 250 to 2100 lb_m/ft^2-sec in tubes in which the length-to-diameter (L/D) ratios ranged from 25 to 300 for varying amounts of entrance subcooling. The effects of four different entrance configurations on critical mass flux and liquid superheat were also investigated. Critical pressure ratios (ratio of critical exit pressure to entrance stagnation pressure) for various L/Ds and entrance subcoolings are presented and discussed. Steady-state critical flow was compared to "blowdown" critical flow, and it was found that a "blowdown" can be approximated by a succession of steady states. Visual observations of flow regimes are related to entrance stagnation conditions, and photographs of entrance flow regimes are also presented. The data are compared to four well-known critical-flow models. (19 references) (auth)

28644 (ANL-8136) IMPLICIT TEMPORAL INTEGRATION FOR LONG-DURATION ACCIDENTS IN A STRUCTURAL RESPONSE CODE-STRAW. Schoeberle, D. F.; Kennedy, J. M.; Belytschko, T. B. (Argonne National Lab., Ill. (USA)). Oct 1974. Contract W-31-109-eng-38. 43p. AT.

An iterative, implicit temporal-integration method is described which is applied in the finite-element method for transient, nonlinear dynamic analyses. The method includes a new convergence criterion based on energy balance, which ensures accuracy of the solution without waste of computational effort. The finite-element method used is valid for large-displacement, small-strain problems with material nonlinearities. The method employs a convected-coordinate technique and a direct nodal-force computational scheme for the internal nodal forces. A beam element and hydrodynamic elements are included. The procedure was incorporated into the existing STRAW code for solution on the IBM-370-series computers. The implicit, consistent mass mode of calculation permits a larger time step in the solution of the equations, compared to the explicit, lumped-mass method, so that long-duration accidents can be treated. Six sample problems are included to demonstrate the application of this method. The resulting computer program should be useful for a wide range of problems arising from the two-dimensional structural response of a single-core subassembly during an accident. 14 references. (auth)

28645 (COM-74-11408) SEDIMENTATION OFF THE KEWAUNEE NUCLEAR POWER PLANT. Technical Report. Pezzetta, J. M. (Wisconsin Univ., Greenbay (USA). Coll. of Environmental Sciences). Mar 1974. 68p. (WIS-SG-74-221; NOAA-74080103). NTIS $3.75.

A comparative two-year study of the nearshore sedimentary environment of Lake Michigan was undertaken to provide basic information on the physical characteristics of the lake bottom and beach zone in the vicinity of the condenser cooling water discharge flume of the Kewaunee Nuclear Power Plant located near Two Creeks, Wisconsin. The pre-operational data have indicated that the sedimentary processes operative along this segment of the lakeshore are controlled largely by a shallow, hard, clay-covered, dolomitic bedrock promontory which forms an extension of the point of land upon which the plant has been constructed. Monitoring of the sediment field and adjacent shoreline after the plant is in operation should indicate whether the jet flow of discharged cooling water will adversely affect the natural sedimentary processes operative in the near-shore environment. (auth)

28646 (ETR-1003) VELOCITIES OF TORNADO GENERATED MISSILES. Iotti, R. C. (Ebasco Services, Inc., New York (USA)). 1974. 59p.

A rational procedure of calculating the velocities of tornado generated missiles is presented. A tornado model has been developed to compute velocities reached by missiles injected in tornadic wind field, in order that their hazards to nuclear installations be properly assessed. The model is compared with similar models developed by others. A spectrum of typical missiles has been selected and their behavior has been evaluated in tornadic wind fields of four different intensities ranging from 200 mph to 360 mph. In order to establish a design basis missile spectrum to be used in assessing the hazards to the nuclear plant, the criterion chosen to select a design basis velocity for each missile is that the overall probability of having any tornado striking the plant site, coupled with the probability of that tornado attaining winds of a given intensity, and further multiplied by the probability of generating a missile of the design basis velocity be equal to or less than 10^{-7}, considering the possibility of having multiple missiles. This value of probability for a design basis event provides an acceptable conservative criterion for design evaluation when one assumes that the combined probability of the generated missile impacting a critical component, of impacting at the "worst" angle for most damaging penetration, and the probability that, if struck, loss of system function occurs together with a single failure in the damaged system's redundant counterpart, if any, is unity. (10 references) (auth)

28647 (GAI-TR-102) DESIGN PARAMETERS FOR TORNADO GENERATED MISSILES. Revision 1. Lee, A. J. H. (Gilbert Associates, Inc., Reading, Pa. (USA)). 17 Jan 1975. 53p. Gilbert Associates, Inc., Reading, PA.

One of the factors considered in nuclear plant design is the protection of safety class structures from possible tornado damage. A number of potentially damaging objects such as wood planks, steel rods, utility poles, automobiles, etc., can be picked up by a tornado and hurled through the air. These objects, once airborne, are referred to as tornado missiles. The design parameters for a list of missiles are established according to the requirements of Section 3.5.3 of USAEC'S Design Guide, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants" Revision 1. The design parameters which are of particular interest in this report are the design impact velocities and the maximum possible heights that tornado missiles can reach. 13 references. (auth)

28648 (GEAP-14034-1) RADIOLOGICAL ASSESSMENT MODELS. First Quarterly Report, July-November 1974. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Dec 1974. Contract AT(04-3)-893. 12p. Dep. NTIS $4.00.

The objectives of this program are to develop models for analyzing or evaluating potential radiological source terms, aerosol phenomena, sodium fires, and radiological dosages associated with the LMFBR. The work performed during this reporting period centered on reviewing the current technology of radiological modeling and assessment techniques. Models for analyzing aerosol behavior and vapor bubble collapse were examined and evaluated. In addition, work on updating and implementing sodium fire and dosage codes was initiated. 11 references. (auth)

28649 (HEDL-SA-755) DAMAGE FUNCTION ANALYSIS. McElroy, W. N.; Simons, R. L.; Doran, D. G.; Odette, G. R. (Hanford Engineering Development Lab., Richland, Wash. (USA); California Univ., Santa Barbara (USA)). 21 Oct 1974. Contract AT(45-1)-2170. 34p. (CONF-741207-2). Dep. NTIS $4.75.

From American Society for testing materials mini-symposium on neutron asymmetry and spectrum analysis for materials applications; San Diego, California, USA (2 Dec 1974).

The current status and procedures associated with "Damage Function Analysis" as it applies to the development, design, and operation of nuclear reactors are reviewed. Damage function analysis provides a systematic applied engineering approach for estimating fluence limits and their uncertainties for neutron induced property changes for reactor materials and components. A summary of derived quasi-empirical damage functions is provided and emphasis is placed on the need for standardization in their definition and application. Included is a discussion of the calculation and use of displacement production as an energy dependent measure of exposure and displacement cross sections for damage function analysis. A brief review is given of the current and projected status of the neutron flux-fluence-spectra characterization that is essential for damage function analysis. (auth)

28650 (INIS-mf-1551) SAFETY OF NUCLEAR PLANTS. A Report from the German Viewpoint. Franzen, L. F. (Norsk Atomenergiforening, Oslo). 1974. 94-112p. (In German). INIS.

The present situation in Germany with regard to the nuclear power programme, reactor safety and public opinion is briefly

presented. Thereafter the future development in power demand is discussed and the German view on safety philosophy presented. This latter is based on the highest degree of safety attainable having regard to economic and social aspects. Siting questions are discussed and certain concrete problems, aircraft accidents, and sabotage are treated. (INIS)

28651 (JAERI-1235) EUREKA: A COMPUTER CODE FOR URANIUM-OXIDE FUELED, WATER-COOLED REACTOR KINETIC ANALYSIS. Ishikawa, M.; Ohnishi, N.; Kanbayashi, Y.; Kuge, Y.; Takeuchi, E. (Japan Atomic Energy Research Inst., Tokyo). Sep 1974. 76p. Dep. NTIS (US Sales Only).

EUREKA, a computer code for uranium-oxide fueled, water cooled reactor kinetic analysis, has been developed in order to analyze neutronic, thermal and hydrodynamic transient behaviors in light water power reactors. EUREKA can analyze the transient response of the core against the reactivity change caused by control rod drop (or withdrawal), coolant flow change and/or coolant temperature change. Especially, it can well simulate fast transient behaviors represented by serious reactivity accidents. In this code, coupled neutronic and thermal-hydrodynamic response is calculated for multi-regions in the core although one point neutron kinetics, one-dimensional heat transfer and one-dimensional hydrodynamics model is applied. SPERT-III E-core experimental results were used to check the adequacy of EUREKA. It has been shown that the calculation results of EUREKA are in excellent agreement with the experimental results with regard to transient power shapes, burst energies, reactivity feedback and others. The code was written in FORTRAN IV language for CDC-6600, IBM-360/75 and FACOM-230/60. Detailed descriptions of the code, including basic equations, lists of input and output and the evaluation of the test calculations are presented. (auth)

28652 (JAERI-M-5719) ANALYSIS OF THE BLOWDOWN BEHAVIOR OF JPDR-II WITH CODE RELAP-3. Ishikawa, M.; Ohnishi, N.; Akimoto, M.; Kishi, A. (Japan Atomic Energy Research Inst., Tokyo). May 1974. 73p. (In Japanese).

An analysis of the JPDR-II blowdown behavior has been made to predict the thermal-hydraulic phenomena during large break LOCA in study of the JPDR-II safety (90 MW(t) BWR with two loops), using code RELAP-3. The RELAP-3 as the U. S. AEC analysis model for LOCA was received from Idaho Nuclear Corporation. A series of the sensitive studies was also made on the number of nodes, discharge coefficient and other important input parameters, to obtain suitable analytical techniques and meaningful input data. (auth)

28653 (JAERI-M-5749) EFFECT OF HELIUM ON THE MECHANICAL PROPERTIES OF ZIRCALOY CLADDING DURING A LOSS-OF-COOLANT ACCIDENT. Furuta, T.; Kawasaki, S. (Japan Atomic Energy Research Inst., Tokyo). Jun 1974. 14p. (In Japanese). Dep. NTIS (US Sales Only).

The effect of helium produced by a (n, α) reaction on the behavior of zircaloy cladding during a loss-of-coolant accident has been studied. Stress-rupture tests were conducted at 800°C for the zircaloy-4 injected with 0.5 and 5 ppm helium. In light-water power reactors, the helium yield amounts to a few ppm in normal operation. From the tests, it was found that with over 0.5 ppm of helium in the cladding the rupture strength and the time to rupture of the specimens decreased, but the elongation to rupture increased in spite of helium injection. (auth)

28654 (LA-5870-PR) HTGR SAFETY RESEARCH PROGRAM. Quarterly Report, October–December 1974. Kirk, W. L. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1975. Contract W-7405-eng-36. 51p. Dep. NTIS $5.45.

Information on HTGR safety research is presented concerning fission product release under normal and accident conditions, primary coolant impurities, structural investigations, safety instrumentation and control systems, and phenomena modeling and systems analysis. 44 references. (DCC)

28655 (NP–20327) OXIDE-3: A COMPUTER CODE FOR ANALYSIS OF HTGR STEAM AND AIR INGRESS ACCIDENTS, AMENDMENT 1. (General Atomic Co., San Diego, Calif. (USA)). 6 Jan 1975. 111p.

Revised and requested information is presented concerning the OXIDE-3 computer program for HTGR steam and air ingress accidents. (DCC)

28656 (ORNL-TM-4568) ORFAD, A COMPUTER PROGRAM TO ESTIMATE FOG AND DRIFT FROM WET COOLING TOWERS. Wilson, J. V. (Oak Ridge National Lab., Tenn. (USA)). Jan 1975. Contract W-7405-eng-26. 33p. Dep. NTIS $4.75.

A method of estimating the number of hours when fog and ice will result from wet cooling tower operation and the amount of dissolved solids that will be deposited at different directions and distances from such towers is described. A computer program using the method is described, and instructions for preparing the data for the program and using it are given. The program uses hourly weather data from tapes. It calculates appropriate values of plume rise and dispersion for the weather conditions, thence calculates vapor density where the plume reaches the ground, and calculates particle deposition rates and fogging from the vapor density. (auth)

28657 (ORNL-TM-4805(Vol.2)) QUARTERLY PROGRESS REPORT ON REACTOR SAFETY PROGRAMS SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH FOR OCTOBER–DECEMBER 1974. II. Heavy-Section Steel Technology Program. Whitman, G. D. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 99p. Dep. NTIS $5.45.

Information on the heavy-section steel technology program for water-cooled reactor pressure vessels is presented concerning fracture mechanics analyses and investigations, effect of high-temperature primary reactor water on the subcritical crack growth of reactor vessel steel, investigations of irradiated materials, pressure vessel investigations, and thermal shock investigations. (DCC)

28658 (PB-236312) FORCED VIBRATIONS OF CIRCULAR FOUNDATIONS ON LAYERED MEDIA. Research Report. Kausel, E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Civil Engineering). Jan 1974. 242p. (R-74-11; NSF-GI-35139-4). NTIS $7.50.

The general three-dimensional problem of an axisymmetric footing resting on (or embedded in) a semi-infinite viscoelastic layered stratum and subjected to arbitrary non-axisymmetric forced excitations is investigated by means of finite elements using a consistent energy-absorbing boundary. Comparisons are made with known analytical solutions for special cases involving parametric variations of the relative dimensions, properties and/or geometry. A general agreement with the theoretical halfspace solution is found, as well as with the results obtained from an approximate equivalent plane strain model. (GRA)

28659 (PB-236449) DYNAMIC RESPONSE OF STRUCTURES IN LAYERED SOILS. Research Report. Laing, V. C. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Civil Engineering). Jan 1974. 199p. (R-74-10; NSF-GI-35139-3). NTIS $7.00.

The dynamic response of a strip footing resting on or embedded in a soil stratum is studied. The cases investigated cover the excitation of the footing by horizontal forces and rocking moments, and the motion due to a specified displacement at bedrock. The study is based on a finite element formulation with appropriate energy absorbing boundaries, which consist of semi-infinite layered regions extending to the left and right of the finite element region. The effect of layer thickness and the convergence towards the half-space solution are investigated. The effect of embedment is considered, comparing the response of an embedded footing to that of the same footing at the surface. The interaction between adjacent footings is studied. The results obtained suggest that some of the effects studied might be reasonably well reproduced by applying simple correction factors to the half-space solution. (GRA)

28660 (RN-S-0431) NERVA FLIGHT MALFUNCTION STUDIES. Vanica, D. F. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1967. 56p. Dep. NTIS $6.00.

The results of studies conducted to evaluate the safeness of nuclear rocket operation during the suborbital phase of a 72-hour lunar-transfer mission are presented. A reference mission and trajectory profile which establish the critical flight-safety interval are defined. Auxiliary thrust system and delta-V requirements for controlled deep-ocean disposal are established. An accident model resulting in a loss of mission is described: engine-system failure modes and failure probabilities are discussed. Non-nuclear component response to a loss-of-coolant accident is defined, and emergency auxiliary cooling requirements and system concepts are presented. The effect of an anti-criticality poison system on nuclear rocket operation is discussed. (auth)

28661 (RT/PROT-(74)24) DYNAMS: DYNAMICS OF AN EXPERIMENTAL LIQUID-METAL COOLED FAST REACTOR. Scafe, R. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Oct 1974. 133p. (In Italian). Dep. NTIS (US Sales Only) $9.75.

A program for the analysis of operational or accident transients of a liquid-metal cooled fast reactor which dissipates in the atmosphere the heat produced is presented. The program calculates the temperature distribution and the coolant flow in the components of three coolant loops: the loops are of two different types and each of them is composed of a primary, a secondary and a tertiary. The code can take into account both natural circulation and the

distributed component of head losses. Longitudinal thermal conduction in the liquid metal and thermal losses are not taken into account. The program is written in FORTRAN IV for IBM 370/165 computers. (auth)

28662 (SAND-75-6000) EXPERIMENTAL RELEASE OF FISSION PRODUCTS IN HYPOTHETICAL REACTOR ACCIDENTS. Albrecht, H.; Perinic, D. 7 Feb 1975. Translation by Roya L. Tinsley, Jr. of KFK-EXT.-28/74-2. (CONF-741148-1). 25p. Dep. NTIS $4.25.

From annual reunion of the nuclear safety projects; Karlsruhe, F. R. Germany (19 Nov 1974).

Experimental facilities and initial preliminary experiments to investigate fission product release rates and mechanisms following the meltdown of a hypothetical 3000 MW(t) reactor core after one year of operation are described. The magnitude and significance of the radioactive inventory of the reactor, the parameters of the release, and the present state of knowledge of fission product release are discussed. A high-frequency induction furnace simulates core meltdown by heating a mixture of UO_2, steel, and Zircaloy. The melt also contains fission and activation products for monitoring with a γ-spectroscope. (DG)

28663 (SAND-75-6001) MELTDOWN BEHAVIOR OF LWR FUEL RODS. Hoffmann, P.; Holleck, H.; Hagen, S. 7 Feb 1975. Translation by Royal L. Tinsley, Jr. of KFK-Ext. 28/74-2. (CONF-741148-2). 36p. Dep. NTIS $5.00.

From annual reunion of the nuclear safety projects; Karlsruhe, F. R. Germany (19 Nov 1974).

A description is given of experimental investigations to provide a phenomenological description of the meltdown process and to characterize the associated phases with respect to their composition and melting points. Initial results indicate that the meltdown behavior depends strongly on the oxygen content of the atmosphere or on the degree of oxidation of the core components. (DG)

28664 (STF-60-A74063) NUCLEAR POWER PLANT IN THE OSLOFJORD DISTRICT. Report 13. Summary of Hydrophysical Recipient Evaluations for the Site Alternatives Naverfjorden and Langangfjorden Saga. Audunson, T.; Eide, L. I.; Rye, H.; Thendrup, A. (Trondheim Univ. (Norway). Vassdrags- og Havnelaboratoriet). Jun 1974. 122p. (In Norwegian). INIS.

The hydrophysical conditions in the Outer Oslofjord area around Langesund Bay and outside the Naverfjord and the Hummerbakfjord are evaluated as a part of the investigation of potential nuclear power plant sites in the Oslofjord district. A preliminary evaluation is given of the changes to be expected in the hydrophysical environment as a result of the discharge of 200 (100) m^3/s of cooling water heated by 10°C in the Langangsfjord and the Hummerbakfjord respectively. (INIS)

28665 (TID-7653-P2(P1 and 2), pp 184-191) ROVER REACTOR POWER TRANSIENT CALCULATIONS. Stratton, W. R.; Chezem, C. G. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Two codes in use for analyzing nuclear power excursions in Kiwi-B-4 type reactors are discussed. These are the RTS and RAC codes. The RTS code allows an exact treatment of delayed neutron effects but is space-independent. The RAC code provides for detailed treatment of materials (thermal expansion, phase change, etc.) and some geometries, but contains only a very simple neutronic scheme. Accidents severe enough to create about 2×10^{20} fissions will vaporize some graphite and create a small explosion. Control-rod-created excursions do not reach this magnitude, but conceptual water immersion accidents could be as large as 3×10^{20} fissions. (auth)

28666 (TID-7653-P2(P1 and 2), pp 192-202) NUCLEAR ROCKETS: SAFETY PROBLEMS AND SAFETY PROGRAMS. Dix, G. P. (AEC/NASA, Washington, DC). 1962.

In proceedings of nuclear propulsion conference.

The potential safety problems associated with nuclear rockets, countermeasure philosophy, and safety programs are presented. Reference is made to causal non-nuclear accidents, which are defined as the event or series of events culminating in a nuclear incident. Both the causal accidents and potential nuclear incidents are sufficiently well known to allow the engineering of safety devices and the formulation of safety procedures to prevent, override, or minimize nuclear incidents. The philosophy adopted is to assume that certain credible causal accidents will occur and provide reliable countermeasure devices to assure nuclear safety. (auth)

28667 (TID-7653-P2(P1 and 2), pp 203-214) NUCLEAR SAFETY AND HAZARDS ASPECTS OF RIFT FLIGHT OPERATIONS. Rives, J. M. (George C. Marshall Space Flight Center, Huntsville, AL). 1962.

In proceedings of nuclear propulsion conference.

The nuclear safety and hazards considerations for RIFT static test operations and RIFT flight tests are discussed in general terms. The RIFT vehicle system and facilities are briefly described with particular emphasis on the safety aspects. Since the RIFT Program has as one of its main objectives to demonstrate safe operation of the RIFT vehicle, the safety features and mechanisms incorporated into the system design and operation are evaluated. Safety analysis is conducted to determine all conceivable hazards for all RIFT operations. (auth)

28668 (TID-26724) 6KILER, VER 001, A DIGITAL COMPUTER CODE FOR BWR/6 CORE HEAT TRANSFER ANALYSIS. Griebe, R. W.; Richert, K. D.; Radd, M. E.; Moser, C. M. (Energy, Inc., Idaho Falls, Idaho (USA)). Feb 1974. 42p. (EI-74-5). Dep. NTIS $5.25.

User information for the computer code 6KILER VER 001 is presented. The core heat transfer code 6KILER was developed for predictive and post-test analyses of core heat transfer during a LOCA for a General Electric BWR/6 type plant. The code utilizes models that describe thermal radiation, metal-water reaction, conduction and convection to steam. The code developed has been evaluated by comparisons between calculated rod surface temperature and experimental temperature for BWR/6 fuel arrays. The computer code, 6KILER VER 001, the BWR/6 fuel array, the heat transfer models utilized in 6KILER, and code operation including organization, flow charts, input, output and a sample input listing are included. 8 references. (auth)

28669 (TID/SNA-507) FLIGHT SAFETY CONTINGENCY ANALYSIS REPORT. Volume III. Nuclear Subsystems Contingency Analysis. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 190p. Dep. NTIS $12.00.

Results of flight safety contingency analyses for fuel elements, cluster hardware, core periphery, support plate and plena, internal shield, and reflector assembly for the NERVA reactor are presented. (JWR)

28670 (TID/SNA-589) EMERGENCY COOLDOWN FOR GROUND TEST. Preliminary ("C" portion only). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 67p. Dep. NTIS $6.50.

A study was made of an emergency cooldown system for the engine based on Drawing No. 1137400C. It was assumed that any time a single malfunction occurs, the engine will be immediately shut down. The results are also applicable to the 400E engine configuration. The emergency cooldown line should be connected to the engine pump discharge line downstream of the PDKVs. The recommendation is based on the premise that failure of the pump discharge line is not a credible malfunction. The emergency cooldown line will have to be flexible across the gimbal point to accommodate alignment of the engine in the test stand. The volume added to the engine by addition of the cooldown line should be minimized by locating the facility check valve or shutoff valve, whichever is finally chosen, in the test-stand adapter. The cooldown line will apply loads on the engine that will have to be considered if thrust measurements are made. The cooldown-line chill should be maintained by LH_2 circulating from the facility independent of the engine. To avoid any question as to the applicability of ground test data to the flight engine, no flow should be allowed from the engine into the emergency cooldown system. This is particularly important for such test requirements as I_{sp} verification. The facility and engine control requirements are interrelated and should be considered early in the controls design work. When dual TPAs are being used, the emergency cooldown system should be available in case both TPAs fail, but should be inoperative if only one fails. For any single-TPA operation, the emergency cooldown system must always be available. (auth)

28671 (TID/SNA-684) FLIGHT SAFETY CONTINGENCY ANALYSIS REPORT, INITIAL DRAFT. Volume II. Appendix B. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 295p. Dep. NTIS $17.75.

Worksheets for NERVA flight safety contingency analysis are presented. The worksheets cover failure modes, detection, failure probability, consequences, and contingency action for all subsystems and all operational phases. (JWR)

28672 (TID/SNA-708) NERVA SAFETY ENGINEERING PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 100p. Dep. NTIS $8.00.

The objective of the program set forth is the prevention, elimination, and control of hazards to personnel, equipment, and property in all activities conducted under Contract SNP-1 as well as in all systems engineered thereunder. Consequently, this plan is concerned with both nuclear and non-nuclear hardware manufacturing and assembly, handling and transport, ground test operations, space vehicle launch, flight operations through ultimate disposal of the nuclear engine, and the effects of normal

and abnormal flight operations on the world population. This plan outlines the scope of the safety activities, defines the manner in which safety tasks are accomplished, describes the safety management structure in effect, identifies key responsibilities with respect to safety tasks and operational safety, and identifies safety documentation requirements. (auth)

28673 (TID/SNA-856) NERVA FLIGHT SAFETY CONTINGENCY PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Dec 1968. 51p. Dep. NTIS $5.75.

28674 (TID/SNM-2) PEWEE REACTOR SAFETY ANALYSIS REPORT. (Los Alamos Scientific Lab., N. Mex. (USA)). 1 Sep 1970. 320p. Dep. NTIS $19.00.

The safety analysis of the Pewee-2 reactor is described. (JWR)

28675 SEISMIC PROOF TESTS USING EXPLOSIVES TO PRODUCE STRONG GROUND MOTION. Taylor, G. B.; Smith, C. B. (Applied Nucleonics Company, Inc., Los Angeles, California, USA); Klopfenstein, A. (Southern California Edison Co., Rosemead (USA)). Nucl. Eng. Des.; 29: No. 2, 202-217(Dec 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

An attempt is made to simulate the 5-10 sec of intense shaking present in typical strong motion earthquake time histories. Research indicates that responses of up to 30 sec can be achieved if the damping is not too high. The procedure for performing a test is first to compute response spectra for a site as a function of the charge size, distance, depth, etc. To do this soil parameters such as shear wave velocity and the depth of soil layers are measured. These data along with information concerning the types and placement of explosives are used as inputs for a computer program. This program, called ANBLAST, computes peak soil responses, frequencies, and determines response spectra for various values of damping. Several types of instruments were used in the measurement of ground, foundation and instrument motion. These include unbonded strain gage accelerometers, a strong motion seismograph, a passive mechanical peak shock recording device, triaxial borehole seismometers, and geophones to measure seismic velocities in the soil. All the instrument outputs were recorded with a wide band FM tape recorder. Subsequent Fourier transform spectra and time response data were obtained from the original tape recordings. The resulting instrument responses agree satisfactorily, showing excellent correlation in measurements made at similar locations using different instruments. In addition, the reduced data and resulting response spectra agree with the expected values obtained from analytical studies. It is felt that tests using strong ground motions produced by explosives allow seismic studies to be made at peak amplitudes and durations approaching those of strong motion earthquakes and open a new dimension in in situ testing of massive devices and structures. (auth)

28676 METHODS OF ASSESSING THE RELIABILITY OF NUCLEAR REACTOR FACILITIES. Emel'yanov, I. Ya.; Klemin, A. I.; Polyakov, E. F. At. Energ. (USSR); 37: No. 5, 408-416(Nov 1974). (In Russian).

A survey of basic concepts, methods, and computer programs for assessing the reliability of nuclear reactor facilities and systems is presented. In addition, a proposed method of assessing the structural reliability of facilities is described in detail. This method is the result of generalization and further development of existing analytical approaches. It is quite exact, universal and suitable for engineering applications, particularly at the stage of selecting the final version of a system structure. (2 figures, 1 table, 13 references) (auth)

28677 HYDRODYNAMICS OF LMFBR EMERGENCY COOLING. Pfann, J.; Macek, J. (Inst. of Nuclear Research, Rez, Czech). Jad. Energ.; 21: No. 1, 3-10(1975). (In Czech).

An analysis of coolant flow transients in a sodium cooled fast reactor with a number of cooling loops is presented. The flow through active core is divided into several parallel branches. Complete pump characteristics have been used in the model which make possible to solve the problem even in the case of flow inversion in the failed loop. The effect of flop valves and manipulation of control valves can be taken into consideration. Simple analytical expressions describing coolant flow transients in the case of simultaneous failure of all pumps (power-supply failure) has been derived. The effect of natural circulation in the primary circuit is involved. In more general cases the numerical solution must be applied. (auth)

28678 LIST OF INCIDENTS IN NUCLEAR POWER PLANTS. Umwelt (Inform. Bundesmin. Inn.); No. 35, 14-18(Oct 1974). (In German).

Condensed compilation and review are presented of incidents in nuclear power plants of which notice has been given either to the Reactor Safety Commission (RSK) or the Committee for internal affairs of the Bundestag, covering the period from October 1971 to September 1974. The causes and consequences of failures are included. Plants under review: KNK, KWO, KKW, KWL, Merlin, KRB, KKS. None of the incidents reported involved uncontrolled release of radioactivity, or release of unduly high amounts of radioactivity, to the environment, nor has there been damage to the population. (GE)

28679 IMPROVED ANALYSIS OF FUEL MOTION DURING AN OVERPOWER EXCURSION. Wider, H. U. Evanston, IL; Northwestern Univ. (1974). 190p. University Microfilms Order No. 74-28,780.

Thesis (Ph. D.).

One of the hypothetical fast reactor accidents currently under investigation is the transient overpower excursion in an LMFBR (Liquid Metal Fast Breeder Reactor). A key segment of this accident is the fuel and sodium coolant motion following the failure of the fuel pins in an irradiated subassembly. An improved numerical analysis of this part of the accident has been carried out. The fuel fission-gas flow in the fuel pin is treated as a homogeneous, compressible, and one-dimensional flow with nonuniform flow cross section. The axial flow of the liquid and/or vaporized coolant and fission gas in the coolant channel is also regarded as homogeneous and compressible, and is modeled with Lagrangian hydrodynamics. The fuel in the channel is assumed to be in the form of particles. The motion of these fuel particles is calculated by solving the momentum equation for representative particles. This represents an explicit treatment of the slip between the fuel and the sodium fission-gas mixture. Each Lagrangian mesh cell containing fuel particles is treated as a single interaction zone, thus leading to a multiple interaction zone treatment. Existing simplified fuel coolant heat transfer coefficients were modified by accounting for the sodium void fraction. The rate of fuel and fission-gas ejection from the pin is based on the assumption of pressure equilibrium between locations in front of and behind the cladding rupture. A computer code, called PLUTO, was written to solve the equations numerically. In the numerical analysis improvements were made regarding shock smearing in two-phase flows and regarding the explicit treatment of slip flows when large density differences between the components exist. Most calculations showed that the sodium in the coolant channel separates rapidly from the injected fuel. This can be due to fission-gas pressure or due to an initial FCI (Fuel Coolant Interaction). The latter is, therefore, self-limiting and not very strong. Because of the early separation of fuel and liquid sodium the fuel is only moved by vapor and gas drag and by pressure gradients during a considerable period of time. Another interesting finding is that the fuel sweepout from the reactor core is slower when the initial FCI is assumed to be stronger. Generally the fuel distribution in the coolant channel is peaked at the rupture location until the lower sodium slug comes back. The momentum of the returning slug and a local FCI at the lower end of the FCI region eventually sweep the fuel in the coolant channels out of the core. Thus, a rather strong negative feedback is produced. If the rupture location is at the midplane of the reactor, a small positive reactivity can initially be produced and even be maintained for a relatively long time in certain cases. A few of the PLUTO results are measurable and lie in the realm of experimentally found results. Due to this and because of the more thorough analysis, the results of this work are believed to be more realistic than the results of earlier analyses. (Diss. Abstr. Int., B)

28680 TRANSIENT THERMAL ANALYSIS OF MOLTEN CORE-REACTOR VESSEL SYSTEMS. Hagan, R. C. Charlottesville, VA; Univ. of Virginia (1974). 241p. University Microfilms Order No. 75-4663.

Thesis (Ph. D.).

LOCA transient thermal analysis is carried out for a reactor design developed for marine application. To analyze the molten core and reactor vessel transient heat exchange resulting from a LOCA followed by a complete failure of the ECCS, transient heat transfer analytic methods were developed. The methods utilize implicit finite difference techniques to investigate the heat transfer situation which has moving phase change boundaries. The phase changes would be the solidification of the molten fuel and the liquefaction of the reactor vessel. The results of the thermal analysis indicated that the molten core could be contained within the pressure vessel if water existed outside the bottom head of the reactor vessel. The water could be provided by an additional safeguard system. (Diss. Abstr. Int., B)

28681 IMPROVED MODELING OF THE FUEL-COOLANT INTERACTION IN THE HYPOTHETICAL CORE-DISRUPTIVE ACCIDENT FOR THE LIQUID-METAL FAST BREEDER REACTOR. Haas, P. M. Charlottesville, VA; Univ. of Virginia (1974). 237p. University Microfilms Order No. 74-29,196.

Thesis (Ph. D.).

Improvements in mathematical modeling of the fuel-coolant interaction (FCI) as part of the analysis of the hypothetical core disruptive accident for the liquid-metal fast breeder reactor are presented. Because of the many uncertainties associated with the details of the FCI phenomenon, early models made conservative simplifying approximations. Modeling improvements designed to overcome some of the limitations of the earlier models are described in the areas of basic heat transfer process, noncoherence of fuel-sodium mixing, particle-size distribution, condensation effects, and two-dimensional expansion. Parametric studies and illustrative calculations using the models are presented. (Diss. Abstr. Int., B)

28682 REMOVAL OF KRYPTON-85 AND TRITIUM FROM NUCLEAR POWER STATIONS. Koyama, H.; Ishihara, Y.; Takagi, S.; Ohtou, Y. (Central Research Inst. of Electric Power Industry, Tokyo). Denryoku Chuo Kenkyusho Gijutsu Daiichi Kenkyusho; No. 73046, 1-58(Mar 1974). (In Japanese).

Results of investigations of the production, release, and removal of krypton 85 and tritium by nuclear facilities are discussed. Most of the krypton 85 produced in fuel rods was released to the atmosphere from the fuel reprocessing plant, with very little being released from the nuclear power plant. Several krypton 85 removal processes under development are not yet in practice. The following development order should be recommended to reduce global contamination by krypton 85: (1) prompt construction of krypton 85 removal systems at fuel reprocessing plants, (2) development of krypton 85 removal processes in PWR and LMFBR cover gas systems, (3) development of krypton 85 removal processes for the off gas streams of ATR, AGR, and BWR type reactors. The greater part of tritium was yielded by ternary fission and nuclear reaction of boron (especially in the case of PWR). Although the release ratio is variable in accordance with a reactor type, only a small percentage of tritium produced in the reactor core may be released from nuclear power stations. Tritium removal procedures under consideration are: electrolysis, thermal diffusion, distillation of water or hydrogen, gas chromatography, gaseous diffusion, and isotopic exchange. In order to apply these procedures to tritium removal, further experimental research should be carried out considering conditions at nuclear power stations. (auth)

28683 QUESTIONS ABOUT CANADIAN NUCLEAR POWER. Foster, J. S.; Stewart, G. C. (Atomic Energy of Canada Ltd., Ottawa). pp 90-106 of Energy and the Environment. Efford, I. E. (ed.). Vancouver, B. C.; Univ. of British Columbia (1972).

Some questions peculiar to the Canadian nuclear power program are dealt with, specifically the escape of radionuclides from Canadian power reactors, the storage of spent fuel, and accident mechanisms and probabilities in the CANDU reactor concept. (CA)

28684 PROFUSION: COMPUTER CODE TO EVALUATE REACTIVITY CHANGES DUE TO MOLTEN FUEL SLUMPING AND SOLID FUEL COLLAPSE. Renard, A.; Stievenart, M. (Belgonucleaire S. A., Brussels). pp 1285-1302 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. III. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P3.

The code PROFUSION was initially developed to evaluate the reactivity changes which could be associated with molten fuel slumping in an oxide fuelled fast reactor with two enrichment zones. The code calculates in a two-dimensional mesh the creation of central voids resulting from the migration of porosities inside oxide fuel pins, the propagation of fuel melting as a result of an important overpower or undercooling and the displacement of molten fuel in the central voids according to several schemes. In transient conditions, the latent heat of fusion can be taken into account by means of a melting front movement. The reactivity effects are evaluated by means of a perturbation formula using 2D fuel reactivity worth distribution and validated by neutron diffusion calculations. 4 references. (auth)

28685 EXPERIMENTS IN MEASUREMENT OF DYNAMIC CHARACTERISTICS OF BN 350. Kuznetsov, I. A.; Antuf'ev, O.; Buksha, Yu. K.; Dvoryanskov, V. P. pp 439-443 of Fast Reactor Power Stations. London; British Nuclear Energy Society (1974).

From conference on fast reactor power stations; London, UK (11 Mar 1974). See CONF-740318-.

During the startup period of the BN 350, a big program of experiments was carried out in the measurement of the dynamic characteristics of the reactor and its systems for determining the behavior of the plant under unstable and fault conditions and consequently reliability and safety in operation. The results of these experiments are now being treated. The following deals with experiments investigating hydraulic transient processes in the circuits of the plant, measuring the hydrodynamic effects of reactivity. (auth)

28686 ACTUAL PROBLEMS CONCERNING CONSTRUCTION AND OPERATION OF NUCLEAR POWER PLANTS. Mareske, A. Energiewirt. Tagesfragen; 24: No. 10, 482-487(Oct 1974). (In German).

4 figs.; 6 refs.

The following problems are discussed: 1) acceleration of capacity expansion; 2) stabilization and improvement of operational safety; and 3) new reactor concepts (high temperature reactors, fast breeders). Problems of environmental effects, accident risk, and of standardization are also dealt with. (GE)

28687 IN-PILE STUDY OF THERMAL INTERACTIONS BETWEEN HIGH-ENERGY MOLTEN UO_2 FUEL AND LIQUID SODIUM. Zivi, S. M.; Epstein, M.; Wright, R. W.; Barghusen, J. J.; Cho, D. H.; Testa, F. J.; Goldfuss, G. T.; Mouring, R. W. (Argonne National Laboratory, IL). Nucl. Sci. Eng.; 56: No. 3, 229-240(Mar 1975).

Two in-pile transient experiments were performed in the TREAT Reactor Facility to investigate fuel-coolant interaction phenomena that might occur in a hypothetical promptburst disassembly accident involving extensive fuel vaporization in a nearly unvoided liquid-metal fast breeder reactor core. In these tests, a single fuel pin containing 28 g of UO_2 was subjected to a self-limited 23-msec-period TREAT power excursion which deposited fission energy of 1700 cal/g of UO_2 in the fuel. The pin was contained in an instrumented autoclave filled with stagnant sodium. Failure of the fuel pins occurred at a mean energy input of about 540 cal/g, corresponding to a UO_2 vapor pressure of about 100 atm. Results of these tests indicated that no energetic fuel-coolant interaction was produced and that the measured transient pressures can be reasonably described by the time history of the fuel vapor pressure. (auth)

28688 BIBLIOGRAPHY OF THE SOCIAL EFFECTS OF NUCLEAR POWER (1945-1973). Coleman, B. Vancouver, British Columbia; British Columbia Hydro and Power Authority (1974). 188p.

The references from 1945 to 1973 that consider those issues that are at the center of the public discussion of nuclear power have been recorded. The references are grouped in chapters under the headings of environment, general topics, health physics, location of nuclear power plants, radioactive wastes, reactor safety, social relations, thermal effects, and transportation of radioactive materials. An author-subject index is provided. (CA)

Reactor Theory and Calculation

Refer also to abstracts 27507, 28031, 28048, and 28072.

28689 (CONF-7209124-) NUCLEAR DATA AND REACTOR PHYSICS. Proceedings of the International Summer School, Predeal, Romania, September 12–21, 1972. Purica, I. I. (Ed.). (Institutul de Fizica Atomica, Bucharest (Romania)). 1974. 690p. (In English and French).

Separate abstracts or title listings are included for each of the 22 papers presented concerning nuclear data and reactor physics. (DCC)

For abstracts of individual papers see: 27507–27509, 27576, 27654, 27665, 27681, 28004, 28005, 28048, and 28690–28701.

28690 (CONF-7209124-, pp 139-158) INTEGRAL TRANSPORT THEORY. Benoist, P. (CEN, Saclay, France). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

Information on the use of integral transport theory for reactor kinetics calculations is presented concerning the basis of integral transport theory, computer codes calculating the collision probabilities, the ABH method, improvements to the ALCOLL-CORTINA code, and the APOLLO code. 9 references. (DCC)

28691 (CONF-7209124-, pp 159-174) C_N METHOD OF SOLVING OF THE BOLTZMANN EQUATION. Benoist, P. (CEN, Saclay, France). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

28692 (CONF-7209124-, pp 175-208) APPLICATION OF THE INTEGRAL TRANSFORM METHOD TO CELL CALCULATIONS. Copic, M. (Institut Josef Stefan, Ljubljana, Yugoslavia). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

Using the integral transform method in its lowest approximation, IT_0Y_1, an approximate transport equation for the cell averaged angular flux is derived that takes into account all first order anisotropic effects of a simple square lattice. Higher order approximations are discussed and the application of the method to the fast reactor multigroup calculations is suggested to include the heterogeneity effects. (12 references) (auth)

28693 (CONF-7209124-, pp 209-228) INTERPRETATION OF THE SPACE-TIME REACTOR KINETICS BY HETEROGENEOUS REACTOR THEORY. Raisic, N. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

28694 (CONF-7209124-, pp 286-299) MATHEMATICAL POSSIBILITY TO TEST MULTIGROUP FORMALISM. Cuculeanu, V. (Inst. of Atomic Physics, Bucharest). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

28695 (CONF-7209124-, pp 341-343) NEUTRON SPECTRUM MEASUREMENTS AND UNFOLDING IN CRIP. Fischer, A. (Central Research Inst. of Physics, Budapest). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

28696 (CONF-7209124-, pp 344-347) REACTOR PHYSICS CALCULATION ACTIVITY IN CENTRAL RESEARCH INSTITUTE OF PHYSICS, BUDAPEST. Gado, J. (Central Research Inst. of Physics, Budapest). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

28697 (CONF-7209124-, pp 357-399) PHYSICS OF REACTORS WITH IRRADIATED CORES. Vidal, R. (CEN, Fontenay-aux-Roses, France). 1974. (In French).

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

28698 (CONF-7209124-, pp 577-609) DECISION THEORY PROBLEMS IN NUCLEAR DATA AND REACTOR PHYSICS. Purica, I. I. (Inst. of Atomic Physics, Bucharest). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

28699 (CONF-7209124-, pp 610-643) BREEDING OPTIMIZATION BY GAME THEORY. Pavelescu, M. (Inst. of Atomic Physics, Bucharest). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

Results are presented for reactors in couple $^{238}U-^{239}Pu$ with Na coolant and Al and Fe as structural materials for neutron transport theory calculations in monodimensional geometry and metallic fuels. 12 references. (auth)

28700 (CONF-7209124-, pp 644-663) EFFECTIVE CROSS-SECTIONS AND EFFECTIVE OPERATORS IN DIRECT CALCULATIONS AND IN PERTURBATION THEORY. Storrer, F. (CEN, Cadarache, France). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

28701 (CONF-7209124-, pp 665-675) GENERALIZED PERTURBATION THEORY. Storrer, F. (CEN, Cadarache, France). 1974.

From international summer school on nuclear data and reactor physics; Predeal, Romania (12 Sep 1972).

In nuclear data and reactor physics.

28702 (COO-2461-5) NEW COMPUTATIONAL METHODS FOR THE SOLUTION OF MULTIDIMENSIONAL NEUTRON DIFFUSION PROBLEMS RELATED TO NUCLEAR REACTOR SAFETY ANALYSIS. Progress Report No. 2, October 15, 1974-December 15, 1974. Dorning, J. (Illinois Univ., Urbana (USA)). 1974. Contract AT(11-1)-2461. 6p. Dep. NTIS $4.00.

The convergence, accuracy and computing times for the partial current balance (PCB) method have been studied for simple one- and two-dimensional test problems based on an HTGR model. The PCB (linear) method was found to be three to thirteen times as fast as the finite difference method for a given accuracy for the one-dimensional problems, depending upon the degree of complexity of the problem. It was two to seven times as fast as the finite element (linear) method. The advantages of the PCB method over the other methods increased as the degree of problem complexity was increased, and as the required accuracy was increased. The advantages of the PCB method over the finite difference method were even more dramatic when comparisons were made for the two-dimensional problems. The PCB (bilinear) method was four to fifty times as fast as the finite difference method for a given accuracy. Again the advantages of the PCB method over the finite difference method increased as the required accuracy was increased. A further improvement of a factor of about eight was obtained when the PCB (bilinear) calculation was replaced by a PCB (biquadratic) calculation. A method by which the "Green's function" matrix elements can be generated for heterogeneous volume elements has been devised. (auth)

28703 (EURFNR-1231) FAST REACTOR TRANSFER FUNCTIONS WITH SPECIAL REFERENCE TO THE NONLINEARITIES AND TO THE SPATIAL DEPENDENCE OF THE HEAT TRANSFER PROCESS. Caldarola, L.; Ferranti, P.; Mitzel, F. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Oct 1974. 119p. (KFK-2027; EUR-4978e). Dep. NTIS (US Sales Only) $9.00.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Reactor transfer functions which account for the space and time dependent heat transfer in a fuel element as well as for the temperature dependent heat transfer coefficients are considered. Numerical examples are given for the KNK and SEFOR reactors. 7 references. (auth)

28704 (FEI-401) CALCULATION OF VELOCITY AND PRESSURE FIELDS IN THE HYDRAULIC CIRCUIT OF A REACTOR BY ELECTROANALOGUE METHOD. Vladimirov, M. A.; Gochakov, M. K.; Bogov, S. P.; Yurev, Yu. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 37p. (In Russian). INIS.

The problem of the liquid flow in the hydraulic circuits of a reactor was formulated and solved in the linear approximation by the electroanalog method. The inlet collector, the porous active zone, and the output collector were considered in the calculations. (tr-auth)

28705 (FEI-428) SOME IMPORTANT PROBLEMS OF THE REACTOR-PHYSICS DATA ANALYSIS. Van'kov, A. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 15p. (In Russian). INIS.

The following questions were discussed: (1) differences in approaches relating to the analysis of reactor data, (2) non-uniqueness of the concept of the adequacy of experimental and calculational conditions, and (3) interpretation and use of the coefficients of sensitivity, calculated with and without the requirement of reactor criticality. (tr-auth)

28706 (FEI-434) CALCULATION OF A TEMPERATURE FIELD IN ADJACENT CHANNELS WITH REGARD TO TRANSVERSE CONVECTION. Vasilchenko, L. D.; Kashcheev, V. M.; Yurev, Yu. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 14p. (In Russian). INIS.

The problem of heat transfer in two adjacent channels with different heat release was formulated for the condition of a sinusoidal law of the change of the transverse components of the liquid flow. The solution was obtained by computer calculation. The temperature field along and across the channels was determined. On the basis of an example, conclusions were drawn on the dependence of the efficiency of temperature equalization on the intensity of mass exchange. (tr-auth)

28707 (FEI-436) INTEGRAL METHOD FOR SOLUTION OF NEUTRON DIFFUSION GROUP EQUATION STATIONARY SYSTEM IN MULTIZONE REACTOR WITH ABSORPTION ROD SYSTEM IN THE (r,φ) GEOMETRY. Zemskov, E. A.; Isakova, L. Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 13p. (In Russian). INIS.

The integral algorithms for finding the distribution of the neutron spectra and the k_{eff} in a multizone reactor with randomly spaced system of absorption rods are described. The algorithms are based on the division of the original system of diffusion group equations into two systems. The first system with uniform diffusion operators in the left part is reduced to a system of linear equations by the use of Green functions. The second is solved by the Bubnov-Galerkin method. A scheme is given for the construction of the iteration process. (tr-auth)

28708 (FEI-437) CALCULATION METHOD OF TEMPERATURE DECREASING IN "HOT" CHANNELS FOLLOWING HEAT

LEAKAGE. Vladimirov, M. A.; Kashcheev, V. M.; Pykhtina, T. V.; Yur'ev, Yu. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 16p. (In Russian). INIS.

The thermohydraulic calculation of a reactor includes, in addition to the determination of the nominal flow field of the coolant and the fuel temperatures, an evaluation of the statistical spread of the temperature as a result of the random variation of the fuel geometry, the thermophysical characteristics of the materials, and the fuel enrichment. As a result of this type of evaluation the distribution of the maximum temperature of the fuel elements can be obtained through the use of the dispersion of the parameter components. The temperature excess of a given permissible value T of some of the fuel elements can be evaluated with some probability. The obvious fact that the heat flow from superheated fuel elements surrounded by fuel elements with very low temperature is increased and their temperature is somewhat decreased is frequently not considered. In the standard methods the reactor channels are considered to be thermally insulated. The available partial solutions can not always be used in statistical calculations. A solution is given with consideration of the thermal coupling of reactor channels. This makes it possible to evaluate in the general case the effect of the heat flow from superheated fuel elements. (tr-auth)

28709 (FOA-C-4561-A2) CRITICAL PARAMETERS OF SOME U- AND Pu-SYSTEMS. Lefvert, T. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Nov 1973. 22p. (In Swedish). Dep. NTIS (US Sales Only) $4.25.

Critical mass, multiplication factors and time constants have been calculated for spheres containing ^{233}U, ^{235}U with various ^{238}U-content and ^{239}Pu with various ^{240}Pu-content, also for homogeneous ^{239}Pu-cylinders with various height/diameter ratios. Exact scaling laws are given for variations in density and dimensions, by means of which critical parameters are easily determined for systems with densities and dimensions other than those investigated. (SW)

28710 (IAE-2299) EQUATION OF THREE-DIMENSIONAL HETEROGENEOUS REACTOR DYNAMICS. Rumyantsev, A. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 12p. (In Russian). INIS.

A method for the numerical calculation of the neutron dynamics of a three-dimensional heterogeneous reactor is presented. The method of Feinberg-Galanin is modified for the calculation. It is assumed that temperature gradient changes in the fuel and control rods and in the circulating medium are described by known functions of time. In order to analyze "slow" non-steady-state processes in multi-channel circulation a method of calculating dynamic distributions of temperature fields in fuel rods and moderator is proposed. In this case distributions of mass flows, enthalpies and other parameters of the circulating fluid are determined from steady-state modes of operation. (tr-SJR)

28711 (INIS-mf-1383, pp 102-104) EXPERIMENTAL STUDY ON NEUTRON IMPORTANCE SPECTRA IN FAST REACTORS. Voropaev, A. I.; Dulin, V. A.; Kazanskii, Yu. A. 1973. (In Russian).

The possibility of determining the neutron importance function in a fast critical assembly by the time-of-flight method was examined. The evaluation showed that for measurement of the importance function by this method at energy intervals up to 50 keV, a pulsed neutron source with intensity of $\sim 5 \times 10^7$ n/sec is sufficient. (tr-INIS)

28712 (JAERI-1234) CRITICAL EXPERIMENTS AND ANALYSES ON 7 × 7 PuO_2-UO_2 LATTICES IN LIGHT-WATER MODERATED UO_2 CORE. Tsuruta, H.; Matsuura, S.; Kobayashi, I.; Hashimoto, M.; Suzaki, T. (Japan Atomic Energy Research Inst., Tokyo). Jun 1974. 76p. Dep. NTIS (US Sales Only).

A series of critical experiments and analyses on the 7 × 7 PuO_2-UO_2 lattices in a light-water moderated UO_2 core were carried out using the TCA critical facility. The purposes of the present study were: (1) to compare the criticality as well as the neutron flux and power distributions of the plutonium fueled core with those of the uranium fueled core, and (2) to evaluate the accuracy of the current calculational technique in applying to plutonium fueled cores. Multi-regional cores used in these experiments consisted of the central 7 × 7 test lattice with 3.4 wt% PuO_2-UO_2 or 2.6wt% UO_2 fuels, and the surrounding driver lattice with 2.6 wt% UO_2 fuels. Water-to-fuel volume ratio of the 7 × 7 lattice was parametrically changed as 1.76, 2.00, 2.38, and 2.95. Critical core configuration as well as activity and power distributions were measured for every core of them. The unit cell calculations were performed using the multigroup transport code LASER. The neutron balance calculations for the critical cores were performed using the two-dimensional diffusion code PDQ-5. The calculated results agreed with measured values in ±0.3% for the effective multiplication factor, while for the neutron density and power distributions the maximum differences between the calculated and measured values were 16% and 9%, respectively. (auth)

28713 (JAERI-M-5794) RADHEAT: CODE SYSTEM FOR THE RADIATION-HEATING ANALYSIS OF A NUCLEAR REACTOR. Miyasaka, S. I.; Taji, Y.; Inoue, S.; Okada, T.; Minami, K. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 71p. (In Japanese). Dep. NTIS (US Sales Only).

A code system has been developed for radiation-heating analysis of a nuclear reactor. It consists of (1) preparation of the group constants for neutron and gamma-ray transport and energy deposition, (2) preparation of the group constants for secondary gamma-ray production, (3) neutron transport calculation, (4) calculation of heat generation due to neutrons, (5) gamma-ray transport calculation, and (6) calculation of heat generation due to gamma rays. The SN codes, ANISN and TWOTRAN, are employed to calculate the neutron and gamma-ray transport and energy depositions. The energy deposition rates in the core and blanket of the FCA critical assembly V3 were calculated with the code system; the results are compared with those by experiment. (JA)

28714 (JAERI-M-5805) STUDIES ON THE REACTOR NODAL THEORY IN TERMS OF THE MIGRATION KERNEL. Shimooke, T. (Japan Atomic Energy Research Inst., Tokyo). Aug 1974. 69p. (In Japanese). Dep. NTIS (US Sales Only).

The theoretical studies have been performed on the FLARE-type nodal equations. A modified equation is derived, by a semi-empirical method of the result adjustments to the reactor data, in order to solve the theoretical difficulty of the original FLARE equation. A generalized FLARE equation is derived in purely theoretical way using the asymmetric two-group model in one-dimensional systems. The derived equation can be shown to reduce to the original FLARE equation in a special approximate assumption, and also to the above-mentioned modified equation under another theoretical condition. It is made clear from this study that the original FLARE equation is only valid if the node width is relatively small so that the neutron leakages are dominant in epithermal energies (rather than thermal energies), and if the criticality condition is sustained in each node itself. (auth)

28715 (KFKI-73-28) VOID-1, A COMPUTER PROGRAM FOR THE DETERMINATION OF THE VAPOR CONTENT IN THE CHANNELS OF A NUCLEAR REACTOR. Szabados, L.; Techy, Z. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Jun 1973. 22p. (In Hungarian).

A computer code has been developed to calculate vapor void fraction along the reactor channel at any heat flux distribution by the Bowring, Zuber, and Levy models. All the geometrical and physical input data and the physical constants are presented in the output. The Bowring- and the Zuber-subroutines can be used for the calculation of both homogeneous and heterogeneous heat flux, whereas the Levy-subroutine can handle only the case of homogeneous heat flux. The numerical integration is carried out with the F4 INTGRT subroutine. Results of comparison of the numerical results with available test data are presented. The program is written in FORTRAN for an ICL-1905 computer. (INIS)

28716 (NRCN-369) REACTIVITY INSERTION WITH TEMPERATURE FEEDBACK. Ronen, Y.; Schneider, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). May 1974. 16p. INIS.

The kinetic behavior of a point reactor is described. The effect on the reactor of a step function and linear dependence of the reactivity with temperature feedback is discussed. The 3200-MIMIC code is applied, and numerical examples are included. (auth)

28717 (RT/ING-74-6) METHOD OF SCALING IN THE BURN-OUT PHENOMENON IN WATER AND FREON. Cumo, M.; Moronesi, M.; Palazzi, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1974. 19p. (In Italian). INIS.

Scaling theory with particular reference to burn-out phenomena is revised and assessed. As application, the conclusion of an original research on burn-out performed at the Reactor Technology Laboratory of the CNEN is shown. (INIS)

28718 (ZfK-247) DIMOS: A MULTIGROUP MONTE CARLO CODE FOR CRITICALITY CALCULATIONS. Noack, K. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Apr 1973. 10p. INIS.

The Monte Carlo code DIMOS was developed to carry out flux and criticality calculations. The Monte Carlo multigroup method is explained, and the various geometries are described which can be calculated with available standard Monte Carlo programs. The preparation of data from a subgroup library is discussed and future possibilities of its application in Monte Carlo codes are pointed out. Some results of criticality calculations of small fast systems are presented. (auth)

28719 STATE OF THE ART ON REACTOR DIAGNOSTIC TECHNIQUES. Nippon Genshiryoku Gakkaishi; 15: No. 12, 792-808(Dec 1973). (In Japanese).

The diagnosis of the abnormality in nuclear reactors aims at the improvement of the safety and reliability of nuclear reactors and nuclear plants, by detecting and locating the abnormality, estimating the causes of that abnormality, and taking prompt action on that abnormality. In light water reactors, reactor noise analysis has been widely utilized. This method is applied to the reactor noise analysis at zero output to measure dynamic parameters. This is also applied to the reactor noise analysis at power output to get information on the dynamics of reactors. The diagnosis using the detection of reactivity change can be utilized. A thermometer at the outlet of a fuel subassembly can detect the temperature change of coolant to detect abnormalities in fuel pins. The sound technique, which is used to detect sound signals generated by the voids in coolant, can be also applied to the diagnosis. In sodium-cooled fast reactors, whole system diagnosis is performed by neutron flux monitoring, coolant flow rate measurement and reactivity measurement. At the same time, the local diagnosis, which is not performed in light water reactors, is also important, and many detecting systems are proposed and investigated. (JA)

28720 TEMPERATURE DISTRIBUTION IN A SHUT-DOWN NUCLEAR REACTOR. Slesarevskii, S. O.; Korotenko, M. N.; Nazarchuk, M. M.; Pilipets, D. T.; Stel'makh, S. S. Heat Transfer-Sov. Res.; 6: No. 6, 126-128(1974).

Translated from Teplofiz. Teplotekh.; 23: 104-106(1973).

Using a fuel element with embedded thermocouples the temperature distribution in a water-cooled water-moderated reactor was measured during shutdown with prolonged (2-4 hours) cooling of the core. A steep temperature rise was noted at the time when cooling was stopped. Various reactor cooling regimes were compared. (auth)

28721 STATISTICAL TOPICS ON HIGHER HARMONICS SEPARATION IN PULSED SOURCE MEASUREMENTS. Szakats, A. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 8, 793-803(1974).

The statistical aspects of the problem of higher harmonics separation in pulsed source measurements are discussed. Irrespective of the physical significance of these (either space or energy) higher harmonics and the possibility to relate their value to core or assembly characteristics, it is shown that the experimental (or rather computational) effort waged in their separation appears to be worthwhile. (auth)

28722 REACTOR-PERIOD MEASUREMENTS AT LOW POWERS. Vincent, C. H. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). Electron. Lett.; 10: No. 23, 475-476(14 Nov 1974).

A novel method is proposed for the measurement of reactor period in pulse channels at low power levels giving low pulse rates. The method avoids all unnecessary delays and inaccuracies in the reading and gives a statistically optimum performance. (auth)

28723 TRANSIENT REGIMES OF DIRECT CYCLE NUCLEAR POWER PLANTS. Mathematical Model and Program. Sharovarov, G. A.; Struchkov, V. I.; Tashchilova, A. M. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 3, 35-45(1973). (In Russian).

A mathematical model is considered for studying direct cycle nuclear power plants with partial loads. It may be used for studying various engineering schemes, thermodynamic cycles, and heat-transfer agents. Individual units of equipment (reactor, steam generator) are considered with assigned parameters, which make possible the use of variable regimes in a plant with a heat-transfer agent with properties that change rapidly with a change in temperature and pressure. The model was used for studying variable regimes with the dissociating heat exchanger N_2O_4. The studies were made with a universal program on the Minsk-22 computer. (tr-auth)

28724 ONE AND TWO DIMENSIONAL SPACE-ENERGY FLUX SYNTHESIS WITH SPATIALLY DISCONTINUOUS TRIAL FUNCTIONS. Olson, W. O. Corvallis, OR; Oregon State Univ. (1975). 171p. University Microfilms Order No. 74-29,729.

Thesis (Ph. D.).

The use of the space-energy flux synthesis is examined in the context of diffusion theory. One and two dimensional diffusion theory codes have been written to accommodate a very general formulation of the spectral synthesis method. The codes use simultaneous solution methods to eliminate many of the convergence problems previously encountered with overlapping groups, while allowing a wide choice of interface conditions. Numerical experiments using these codes compare various choices of trial functions and types of weighting. A major portion of the investigation concerns the use of different sets of trial functions in different regions (spatially discontinuous trial functions). Particular attention is accorded to trial function and material interface conditions. Results favor conditions which preserve energy integrals of flux and current at interfaces. (Diss. Abstr. Int., B)

28725 ELEMENTS OF NUCLEAR REACTOR ENGINEERING. Lau, L. W. New York; Gordon and Breach, Science Publishers, Inc. (1974). 251p. $29.50.

Chapters are included on nuclear reactions, neutron sources and detection, fission, nuclear reactor plants, neutron cycle, reactor flux distributions and criticality calculations, reactor kinetics and control, heat transfer and fluid flow, radiation hazards and protection, shielding, and fuel cycle and economics. (JWR)

28726 NEUTRON FLUCTUATIONS IN A CRITICAL REACTOR. Lewins, J. (University Coll., London). J. Inst. Nucl. Eng.; 15: No. 5, 131-132(Sep 1974).

Use is made of the exact stochastic solution for a simplified fission model to demonstrate the nature of the Feynman variance-to-mean ratio in the case of a critical system, and on the basis of the exact solution for the binary fission case some conclusions are drawn concerning the general fission case with delayed neutrons. (UK)

28727 NUCLEAR DATA AND INTEGRAL MEASUREMENT CORRELATION FOR FAST REACTORS. Statistical Formulation and Analysis of Methods. The Consistent Approach. Gandini, A.; Petilli, M.; Salvatores, M. (CNEN, Casaccia, Italy). pp 612-628 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P2.

In recent years quite a large literature has been written on the correlation between nuclear data and integral measurements obtained from fast critical assemblies. The statistical foundations are recalled in the light of which mostly used methods so far proposed are analyzed. Emphasis has been given to those arguments which are concerned with systematic error search. The main result is that nothing can be done if systematic errors are present in the integral experiments while in case they exist within the differential data some indication may be obtained by properly exploiting the integral information. In this sort of assessment human judgement appears still to play an essential role. For the application of these methods of correlation, the calculational codes MARA and AMARA.have been written. The first one adopts the so called method by elements, the second one a method using the Lagrange multipliers. A number of numerical cross-checks show the excellent reliability of the results for a class of problems of interest in practical cases. A method of correlation between the basic nuclear parameters and the integral data, consistent with the group cross-section generation program adopted, is finally proposed. Its main advantage consists in its independence from the group schematization chosen and, consequently, in its flexibility with respect to practical cross-section collapsing requirements. 14 references. (auth)

28728 ONE-DIMENSIONAL FAST NEUTRON SPECTRUM CALCULATIONS BASED ON THE NEW CONTINUOUS SLOWING DOWN MODEL. Ito, S.; Yamamoto, H. (Hitachi Ltd., Kanagawa, Japan). pp 705-727 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P2.

Recent works in application of the continuous slowing down theory to fast reactor spectrum calculations have successfully demonstrated its usefulness, in the representation of fine spectra and in the extreme reduction of computation time. However, these works are restricted to the space-independent neutron spectra. An extension to space-dependent problems has been attempted with the use of a new continuous slowing down model typical of the Greuling-Goertzel equation derived by the authors. The numerical treatments, in space-dependent problems, consume surprisingly much time to obtain the results corresponding to the fine or ultra fine group spectra. Therefore, the analytical treatments are carried out as described. The spectrum calculations based on the present method have been compared with fast neutron spectrum measurements in an iron assembly carried out using the KURRI Linac. Microscopic features of the calculated spectrum are in good agreement with the measured one in the intermediate energy region ($30\ keV < E < 1\ MeV$). 16 references. (auth)

28729 NUMERICAL METHOD FOR FAST REACTOR KINETICS EQUATIONS. Cecchini, G. P. (Progettazioni Meccaniche Nu-

cleari, Genoa); Galligani, I.; Meda, N.; Valente, V. pp 1096-1113 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. II. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P2.

The numerical solution of the space-dependent reactor kinetics equations has been receiving increasing attention in recent years. For problems in one and two space dimensions different approximate methods have been developed and also some general codes have been written. All these methods have been oriented to obtain the solution of these problems in reasonable computing time. For this reason, particular attention has been given to alternating direction methods in the case of two space dimension problems. A general method of solution is presented for the two dimensional multigroup kinetics equations which is numerically stable, accurate and rapid in operation. This method is an extension of the two dimensional case of the Cohen Flatt method for the point kinetics equations and of the Andrews–Hansen method for the one-dimensional kinetics equations. The numerical properties of this method are fully described. As a check of the method, some significant localized accidents have been studied in a fast power reactor (the 1000 MW(e) reference reactor design studied at PMN) to reduce the computing time only two energy groups have been adopted, and the delayed neutron source has been considered time-independent for any rate of increase of the prompt neutron fluxes. The results obtained are shown and discussed. 12 references. (auth)

28730 DEVELOPMENTS OF THE JAERI CALCULATION SYSTEMS FOR FAST REACTORS. Katsuragi, S.; Takano, H.; Hasegawa, A.; Suzuki, T.; Kikuchi, Y. (Japan Atomic Energy Research Inst., Ibaraki, Japan). pp 1117-1132 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. III. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P3.

The JAERI fast reactor group constants systems were produced by 1970. Before the production, various computer programs were developed and elaborate analyses were made in order to assure better accuracies of the group constants. Many calculation programs for design and analyses were prepared utilizing the constants systems. The JAERI fast set was originally designed to use for homogeneous mixtures without strong resonance scatterers of medium weight. For heterogeneous medium consisting of plate lattices, investigations have been made so as to extend the applicability of the JAERI fast set. For the purpose, the EXPANDA-75 was prepared based on the integral transport equation and using the JAERI fast set with 70 groups. The ultra fine spectrum calculation code SDR and fine spectrum calculation code ESELEM have also been improved. The comparison of these results shows that the JAERI fast set, although prepared for homogeneous mixtures, can be used for plate type heterogeneity and gives better results for heterogeneity effects, if appropriate effective admixture cross sections are used. Another drawback in the set was the treatment of elastic removal cross sections in case of the medium containing a strong resonance scatterer. An investigation was made in order to obtain an analytical representation of the spectrum around the scattering resonance energy. The elastic removal cross sections can be generated using this spectrum quite easily. The parameters needed in this treatment will be included into the JAERI fast set. 47 references. (auth)

28731 ADJUSTED CROSS SECTION LIBRARY AGLI AND RELIABILITY OF ANALYSIS OF INTEGRAL DATA. Kurol, H.; Mitani, H.; Koyama, K.; Tone, T.; Hirota, J. (Japan Atomic Energy Research Inst., Ibaraki). pp 1188-1206 of Proceedings of the International Symposium on Physics of Fast Reactors. Vol. III. Tokyo; Committee for the International Symposium on Physics of Fast Reactors (1973).

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973). See CONF-731015-P3.

Adjustment of the 1950 energy group cross section library AGLI is carried out using information obtained by the LSQ-method incorporated with 32 data of K_{eff} measurements and 32 data of reaction rate measurements. To elude difficulties in error estimation of cross section data which is essential in the LSQ-method, the LSQ-adjustment is utilized in two steps; to select an appropriate set of differential data among many of them, then to adjust the selected set within relatively small random errors. As the results of performance test of the adjusted library AGLI/2, the following conclusions are obtained: (1) the adjusted data on AGLI/2 are consistent with differential measurements of cross sections, (2) it is proven that AGLI/2 and the computer code system DOYC can predict various integral data with about the same accuracy as those measured by integral experiment. 12 references. (auth)

28732 ENERGY DEPENDENT CONSIDERATIONS IN NON-LINEAR SPACE TIME KINETICS. Singh, O. P.; Vaidyanathan, R.; Singh, R. S. (Reactor Research Centre, Kalpakkam (India). Fast Breeder Test Reactor Design Group). Atomkernenergie; 24: No. 3, 177-179(1974).

2 figs.; 2 tabs.; 6 refs.

An attempt has been made to investigate the energy dependent effects in non-linear prompt neutron kinetics of a nuclear reactor. This pertains to a one-region reactor and involves the expansion effects and spectral change effects as the dominant feedback mechanisms. For a quantitative evaluation, calculations have been made for a fast reactor in which a feedback mechanism due to expansion effects only is considered. Results indicate that the energy-dependent effects are more pronounced for large reactivity excursions. (auth)

28733 A DEFINITION OF A MATERIAL FLUX PARAMETER WITHIN THE FRAMEWORK OF TRANSPORT THEORY. Bulla, W.; Heindler, M. (Technische Hochschule, Graz (Austria). Inst. fuel Theoretische Physik und Reaktorphysik). Atomkernenergie; 24: No. 3, 171-175(1974). (In German).

9 refs.

A new material parameter is introduced to replace the buckling in neutron transport theory without recourse to any approximation. The approximations used in defining the buckling which cannot be deduced from transport theory are reviewed critically. The proposed flux shape parameter is presented as the eigenvalue of an equation depending only on the cross sections of the material. Its role as a parameter of solutions of the transport equation is discussed which may be represented as a product of a function depending on space and direction times a lethargy function specific to the material. It is shown that the flux shape parameter may be deduced from the same measurements as performed to obtain the material buckling. (auth)

28734 NUMERICAL METHOD FOR SOLVING INTEGRAL EQUATIONS OF NEUTRON TRANSPORT. Loyalka, S. K. (Univ. of Missouri, Columbia). Nucl. Sci. Eng.; 56: No. 3, 317-319 (Mar 1975).

A simple, straightforward method of solving the integral equations of neutron transport is discussed. As specific examples, highly accurate results for the Milne's problem for half-space and a black sphere are obtained. (auth)

28735 DIRECTIONALLY DISCONTINUOUS HARMONIC SOLUTIONS OF THE NEUTRON TRANSPORT EQUATION IN SPHERICAL GEOMETRY. Harms, A. A.; Attia, E. A. (McMaster Univ., Hamilton, Ont.). Nucl. Sci. Eng.; 56: No. 3, 310-317(Mar 1975).

An exact infinite-series solution to the one-speed neutron transport equation in spherical geometry is presented. The analysis is based on a partial-range variant of the spherical harmonics formalism and admits arbitrary directional discontinuities in the vector flux. Numerical results are presented to illustrate the appearance of discontinuities in the flux associated with an absorbing sphere. (auth)

28736 RESPONSE MATRICES IN SPACE–TIME REACTOR DYNAMICS. Sicilian, J. M. (Stanford Univ., CA). Nucl. Sci. Eng.; 56: No. 3, 291-300(Mar 1975).

Space-dependent reactor kinetics problems can be solved by response techniques in which subassemblies of the core (called cells) are treated as "black box" transducers of neutron currents. A continuous integral theory of space-time neutronics is presented. This theory is reduced to an approximate response-matrix method, and some monoenergetic one-dimensional problems are solved. The principal advantage over more usual reactor kinetics methods is the achievement of accuracy with a coarse spatial grid. Previously, criticality calculations using response-matrix methods had established this principle. The present work extends the result to time-dependent situations. (auth)

28737 NEUTRON IMPORTANCE AND FISSION DENSITY IN URANIUM-235-ENRICHED URANIUM AND PLUTONIUM METAL SPHERES. Mihalczo, J. T. (Union Carbide Corp., Oak Ridge, TN). Nucl. Sci. Eng.; 56: No. 3, 271-290(Mar 1975).

The spatial distribution of the neutron importance in bare and natural-uranium-reflected uranium (~93.2 wt% ^{235}U) and plutonium (~4.7 at.% ^{240}Pu) metal spheres was measured using ^{252}Cf neutron sources. The spatial distribution of the fission density from activation measurements in the bare spheres and those previously measured for the reflected spheres are presented. Comparison of these distributions with those from S_{16} transport theory calculations showed that the measured and calculated results agreed very well for the bare spheres and in the central core of the reflected spheres. The disagreement in

the natural uranium reflector increased with radius and attained values as large as ~35% at the outer surface. The sensitivity of the calculations to the cross sections is examined. These measurements were undertaken to properly account for spatial effects in the point reactor kinetics description of Rossi-α measurements. The spatial-effects factors obtained from these measurements, which multiply the correlated amplitude of the Rossi-α measurement, were 1.123, 1.109, 1.163, and 1.214 for the bare uranium, bare plutonium, reflected uranium, and reflected plutonium spheres, respectively. The error in these values is ± 0.010. (auth)

28738 INTRODUCTION TO THE STOCHASTIC METHODS FOR THE INVESTIGATION OF THE PHYSICAL PROCESSES IN A NUCLEAR REACTOR. (Mester, A.; Nguyen Xuaan Chi). Stud. Cercet. Fiz.; 26: No. 4, 423-443(1974). (In Rumanian).

Two methods of investigations of the processes taking place in the nuclear reactor using the statistic behavior of the neutron density are presented. At the small powers of the reactor, the Rossi-alfa method is used which allows the determination of some physical parameters of the reactor: the constant of attenuation of the wave of the quick neutrons α_p, the absolute power P. At the same time as the power increases new sources of noise can appear: the vibrations of the combustible elements, the flowing of the cooling fluid, the turbines connected with the system, etc. Because of its origin the power noise can be used in the investigation of the kinetic and dynamic behavior of the reactor and in the investigation of the stability conditions for different power levels. (6 references) (auth)

28739 AIR-WATER TURBULENT MIXING IN SIMULATED ROD BUNDLE GEOMETRIES. Singh, K. Windsor, Ont.; Univ. of Windsor (1972). 122p.

Thesis.

Single-phase air, single-phase water and two-phase air-water mixing experiments have been carried out in simulated square-square and square-triangular rod bundle geometries at 50 psia, using methane and potassium nitrate as the air and water tracers respectively. The variation of turbulent mixing rates with mass flux and quality (for two-phase flow) was investigated over a gap spacing range of 15-80 mils. For single-phase air and water runs, turbulent mixing rates were found to be a function of Reynolds number, gap spacing and subchannel geometry. Secondary flows are believed to exert considerable influence on the mixing rates. For two-phase air-water runs, turbulent mixing rates were quality dependent, exhibiting a maximum in the slug-flow regime. The mixing results for the square-square and triangular-triangular geometries were correlated over a limited parameter range using a Stanton number type mixing parameter. The air and water fractional mixing rates increased with gap spacing but not in the same proportion. Enhanced liquid interchange occurred in the bubble and annular flow regimes while enhanced gas interchange occurred in the slug and slug-annular flow regimes. The results obtained are in qualitative agreement with the high pressure steam-water mixing experiments in similar geometries. (auth)

28740 MATHEMATICAL PROBLEMS OF REACTOR KINETICS. Kuznetsov, Yu. A.; Morozov. (Gorky State Univ., USSR). Dokl. Akad. Nauk SSSR; 218: No. 3, 543-546(21 Sep 1974). (In Russian).

The equations describing reactor kinetics are represented in the operator form and uniquely solved and expanded. (JSR)

28741 STUDIES IN NUCLEAR FUEL-MANAGEMENT. Ibarra, H.; Cabalfin, E. G.; Portugal, A. (Philippine Atomic Research Center, Quezon City). Proc. Radioisotope Soc. Philipp.; 86-96(1973).

Some of the results of fuel depletion calculations based on a bare, one-dimensional, one-speed reactor core model are discussed. Specifically the effect of changes in some of the nuclear parameters on the flux dipping tendencies in the central part fuels in these regions of the core are examined. The exercises, though relatively simple, were first attemps in the systematic studies on nuclear fuel management being conducted in the Philippine Atomic Research Center. Such studies become more important when a nuclear power plant is finally set up in the Philippines. (auth)

Reactor Components and Accessories

Refer also to abstracts 25506, 25507, 25625, 25740, 25741, 26278, 28633, 28642, 28649, and 28761.

28742 (BARC/I-236) RADIOMETRIC TESTING ON THE END-SHIELD FILLED WITH STEEL BALLS. Kakodkar, A.; Soni, M. L.; Ghosh, A. K. (Bhabha Atomic Research Centre, Bombay (India). Reactor Engineering Div.). 1973. 14p. INIS.

A radiometric testing using the attenuation of gamma radiation across a material thickness was used to find out the average thickness, hence the packing density. The calibration was done by placing various thicknesses of steel along the passage of radiation. A 150 m thickness of steel was to correspond to 100% packing density. The theoretical results show an independence of the ball diameter on the average and packing density and void fraction in a particular cross-section. There is some variation in the average packing density in loosely packed structure and the closely packed structure. (INIS)

28743 (CEA-CONF-2688) STUDY OF PRESSURE FLUCTUATIONS GENERATED BY FLOW SINGULARITIES IN A CIRCUIT. Gibert, R. J.; Villard, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 -Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). 1974. 54p. (In French). (CONF-740362-1). Dep. NTIS (US Sales Only) $5.75.

From 17th congress on aeronautical acoustics; Paris, France (20 Mar 1974).

Pressure fluctuations liable to cause mechanical vibrations in fluid-carrying pipes such as reactor cooling circuits were studied, the special conformations investigated consisting of an abrupt widening (sudden passage from a cylindrical tube of diameter d to another of diameter D) and a 7 deg diffuser (gradual passage from a tube of diameter d to one of diameter D). These odd structures set up local fluctuations in the circuit immediately downstream, and generate acoustical fluctuations which propagate by plane waves throughout the circuit. An experimental analysis led to the establishment of simple laws to determine the interspectral characteristics of the acoustic source associated with the irregularity, for any ratio d/D and for any flow-rate. In addition a theory of noise generation by a perturbed flow in internal acoustics was established and allowed the acoustical characteristics of an irregularity to be calculated from the local characteristics. (FR)

28744 (GKSS-74/E/41) MATHEMATICAL METHOD OF DETERMINING SURGE MOTIONS OF FLOATING PLATFORMS IN REGULAR WAVES. Schellin, T. E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1974. 4p. (In German). INIS.

Published in Schiff u. Hafen v. 26(8) 1974.

A method of analysis is described which determines the time dependent surge motions of floating platforms in regular waves. The waves must be small enough to keep the platform heave and pitch motions small. The anchor lines or other stationing systems, the current and the wind are treated as integral parts of the system, permitting an analysis of their effect on platform surge behavior. A sample calculation shows that current and wind can have a major influence on the platform drift and on the stationing force required to keep the platform on location. (auth)

28745 (JAERI-M-5773) DEVELOPMENT OF A LOW-CYCLE FATIGUE TEST CAPSULE. Trial Construction of the Out-of-Pile Capsule and Its Test. Tanaka, I.; Takeyama, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 56p. (In Japanese). Dep. NTIS (US Sales Only).

The capsule being developed is used for low-cycle fatigue tests of reactor structural materials during irradiation. An out-of-pile capsule with a specimen, bellows, etc. and the apparatus consisting of specimen elongation measurement and cyclic tensile load control systems have been constructed in trial and tested, as the first stage of development. Tensile load is applied to the specimen by a bellows-system. To measure the elongation of specimen, two methods were developed, open and closed loop systems. In the open loop system, elongation is measured by means of the output of a differential transformer. In the closed loop system, the coils and core of a differential transformer are null-balanced by a servo-motor, with elongation obtained from the output of a potentiometer which is directly coupled to a servo-motor. A maximum load of 300 kg is possible in the bellows-system. In elongation measurements with a 0.5 mm differential transformer, the errors are 1.8 and 2.0% in 0.5 mm in the open and closed loop systems, respectively. The capsule and its apparatus have been proved to be feasible in the low-cycle fatigue tests during irradiation. (auth)

28746 (LA-5795-C, pp 228-236) MATERIALS FOR NUCLEAR PROCESS HEAT APPLICATIONS. Schumar, J. F. (Argonne National Lab., IL); Simnad, M. Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

An overview of the status of high-temperature materials technology for nuclear process heat application is presented. The materials technology of coated-particle fissile and fertile fuels, graphite structural materials, and helium coolant used in high-temperature gas-cooled reactors is reviewed in terms of applicability to process heat systems. Materials technology of higher temperature metals with gas and liquid-metal coolants developed for space nuclear systems is presented. These materials are important because they can be used at much higher temperatures in nuclear heat sources. (auth)

28747 THE AUSTRIAN PCRV PROJECT WITH A HOT LINER—A STATUS REPORT. Nemet, J. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Forschungszentrum). Nucl. Eng. Des.; 29: No. 2, 189-195(Dec 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The analysis of the problem of PCRV safety leads to a new vessel concept in which the pressure transmitting insulation with its cooling system is outside the hot liner. A control and adjustment system for vessel wall temperature ensures that, under all working conditions, the liner suffers only elastic compression. Outside the thermal insulation (special concrete) a cold steel barrier is placed, which can be constructed as a second liner, so that leaks are limited and can be detected and evacuated. After preliminary development work in the field of high temperature insulating concrete, prestressed concrete technology and instrumentation at elevated temperature, a large experimental ring has been constructed and tested extensively. As part of an experimental high temperature gas loop a large scale model vessel is being built at the Research Center, Seibersdorf, Austria. Construction is nearly complete and a pressure test is scheduled for early 1975. It will be followed by tests under working conditions of PWRs and later of HTGRs. The reference design of such a PCRV with a hot liner for a 1500 MW(e) pressurized water reactor will be finished at the same time as the model vessel. (auth)

28748 NUCLEAR FACILITIES. Surface Cleanliness of Components. pp DIN-25410 of German Norms. Berlin, F. R. Germany; Beuth (Jun 1974). (In German).

This standard defines three degrees of cleanliness and lays down illustrative symbols. Furthermore, it gives indications for the testing of components for maintaining the degrees of cleanliness and for the characterization of the fabrication, assembly and storage regions as well as of packing. The cleanliness requirements are to be fulfilled so that the surface of a component is not damaged or the plant's operational behaviour is not impaired by impurities. The standard gives guide lines for measures in plant fabrication, construction site assembly, transport, storage and packing of components for nuclear technical plants which are to assure that the required degrees of cleanliness are maintained. (GE)

28749 VALVES FOR NUCLEAR FACILITIES. Materials, Fabrication, Testing. pp DIN-25418 B1.1 of German Norms. Draft. Berlin, F. R. Germany; Beuth (Sep 1973). (In German).

The draft describes the scope, the materials, calculation, manufacture, testing and characteristics of valves in nuclear facilities. (GE)

28750 POWER GENERATING PLANT WITH NUCLEAR REACTOR/HEAT STORAGE SYSTEM COMBINATION. Bundy, F. P. (to General Electric Co.). US Patent 3,848,416. 19 Nov 1974. Filed date 23 May 1973. 8p.

Excess heat output of a nuclear reactor is stored at high temperature. This stored heat is then used to generate steam to operate a turbine-generator during high power demand periods. An arrangement is described herein in which a fluoride salt fusion heat storage system is used from which heat is retrieved by circulating liquid lead therethrough. The liquid lead heat retrieval circuit includes a steam boiler in which steam for operation of a turbine-generator is generated using heat extracted from the heated liquid lead. (Official Gazette)

28751 ENCASED BLOWERS OF THE I. BZKG EXPERIMENTAL LOOPS. Matal, O.; Motejl, V.; Pulpan, V. (ZKG, Brno). Jad. Energ.; 21: No. 1, 17-23(1975). (In Czech).

A brief description is given of the encased blowers of the nuclear-power-station steam generator experimental loops in the I. BZKG. Four machines are discussed working with carbon-dioxide under pressure and increased temperature, and experience obtained from their operation. (auth)

28752 CHARACTERISTICS OF A RADIATION HEAT DIVERTER IN UNSTEADY OPERATING REGIME. Avaev, V. N.; Efimov, E. P. Vop. Fiz. Zashch. Reaktorov; No. 6, 165-172 (1974). (In Russian).

Quasi-steady equations describing the operation of the radiation heat diverter were derived. Experimental studies on unsteady operation of the radiation heat diverter were made to determine the heat capacity of the calorimetric system, to determine the time constant when the emf of the measurement casing was determined only by the temperature change of the outer wall of the calorimeter and by the heat release within the measurement volume with comparison of the values obtained, to explain the dependence of the change of emf of the measurement casing with time at constant power within the measurement volume on the placement of heat sources in the measurement volume, and to obtain the dependence of the heat release on time during change of the reactor power. The results of these studies are reported and discussed. (JSR)

28753 HYDROGEN MEASURING DEVICE OF THE DIFFUSION TYPE. Hickam, W. M.; Witkowski, R. E.; Berkley, E. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2178690/D/. 29 Mar 1973. Priority date 30 Mar 1972, USA. 13p. (In (French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A system is described for the measurement of the hydrogen concentration in a gaseous or liquid medium. The system consists of a membrane in the form of a reinforced hollow tube which is placed in the gaseous or liquid medium so that the hydrogen diffuses through the membrane. The diffused hydrogen is extracted by an ion pum in order to maintain a vacuum at the interior of the membrane. The current of the ion pump is an indication of the hydrogen concentration. (tr-FR)

28754 A TIGHT PASSAGE FOR ELECTRICAL CONDUCTORS. Funk, F. E.; Oda, R. T.; Luria, N. G.; Margherone, E. G. (To General Electric Co., Schenectady, N. Y. (USA)). French Patent 2179889/A/. 10 Apr 1973. Priority date 12 Apr 1972, USA. 18p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The device is formed of separate hemetic modules with vapor and liquid tightness. It consists of a hollow passage nozzle sealed in one wall of the enclosure, a sealed hole collector on one end of the nozzle, at least one module sealed in an opening located in the collector and containing a hollow body with a length less than that of the nozzle, at least one electric conductor crossing the hollow body, a means to establish a vapor-tight and pressure-tight joint between the conductor and each end of the body and outlining a space in the body, and a device to pressurize the chamber in order to determine the tightness of the joints. The device can be used in nuclear power plants. (tr-FR)

28755 A METHOD AND DEVICE FOR RESTRICTING THE SEQUELS OF DISTURBANCES IN ATOMIC POWER PLANTS, IN PARTICULAR IN CASE OF LEAKAGE OF THE PRIMARY CIRCUIT HEAT-TRANSFER AGENT. Bukrinsky, A. M.; Turetsky, L. I.; Mironov, V. N.; Rzheznikov, J. V.; Stolyarov, B. M.; Khlestkin, D. A.; Gryzlov, A. G.; Gazizov, V. F.; Matskevich, G. V. (to Vsesojuznyj Nauchno-Issledovatel'skij Inst. Imeni F.E. Dzerzhinskogo (USSR)). French Patent 2177700/A/. 1 Dec 1972. Priority date 30 Mar 1972, USSR. 12p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A reduced pressure with respect to atmospheric pressure is established at the site of the damage by controlled ejection of the slightly radioactive gas from the area with no primary circuit equipment and by condensation of a part of the remaining gas. In comparison to known air-tight protective envelopes, a complete elimination of the escape of the radioactive products to the ambient atmosphere after the loss of air-tightness of the claddings of heat-producing elements is achieved. (tr-FR)

28756 CONTROL SYSTEM FOR RADIOACTIVE HALOGENS. Lee, J. S.; Alves, W. R. (To General Electric Co., Schenectady, N. Y. (USA)). French Patent 2176417/D/. 14 Mar 1973. Priority date 14 Mar 1972, USA. 13p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The fast detection system for radioactive halogen in a gaseous sample having other radioelements consists of two activated carbon filters, two detectors of the sodium iodide crystal type connected with a proportional counter, and a timing device controlling valves to carry alternately to the filters the gaseous sample and the purge gas. (tr-FR)

28757 A TERMINAL DE-SUPERHEATING DEVICE FOR STEAM BY-PASS APPLIANCES. (To Societe des Condenseurs Delas, 75-Paris (France)). French Patent 2180178/D/. 11 Apr 1972. 8p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A terminal de-superheating device for steam by-pass appliances is described. This device, comprising two enclosures mounted one inside the other and from which steam successively flows through appropriate apertures is characterized in that the space defined by these enclosures comprises at least one expansion chamber, followed by at least one spraying chamber followed, in its turn, by at least one outlet chamber, these chambers being separated by steam pervious screens. The device according to the invention can be applied in particular to the steam by-pass appliances of nuclear plants. (FR)

28758 INSTALLATIONS FOR STORING OR HANDLING ENVIRONMENT POLLUTING FLUIDS. (To Societe Babcock-Atlantique, 75-Paris (France)). French Patent 2178291/D/. 27 Mar 1972. 11p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A vessel containing a noxious fluid is mounted in a tank acting in the manner of a secondary barrier (or shield) should the vessel happen to rupture. With a view to preventing the fluid level in the vessel from undesirably dropping, the space between the vessel and the tank is furnished with blocks adapted to roll on a circular track. An opening for a radial track is provided in the tank for admitting an inspection or repair truck into the space and bringing the truck to the desired location. (FR)

28759 PRESSURE-TIGHT REACTOR TANK. Dorner, H. (to Siemens Aktiengesellschaft). US Patent 3,863,410. 4 Feb 1975. Priority date 23 Dec 1971, F. R. Germany. 4p.

The pressure-tight tank of this invention for nuclear reactors consists of a pressure-tight steel tank and a concrete cylinder surrounding the steel tank. The pressure-tight steel tank includes, as separate parts, at least two cylindrical boiler-shells, which are pressure-tight in a radial direction, and a bottom, which is preferably flat. The pressure-tight tank of this invention also includes a concrete cylinder surrounding the steel tank. The concrete cylinder aids in pressing the separate parts of the steel tank together pressure-tight in the axial direction. Pressure-applying elements apply force against an inwardly-domed cover over the steel tank which presses the separate parts of the steel tank together. (Official Gazette)

28760 APPARATUS FOR COOLING LIQUID METALS IN ATOMIC REACTORS. Hanisch, H. (to Gebr. Boehler and Co. AG). US Patent 3,864,210. 4 Feb 1975. Priority date 13 Dec 1971, Austria. 2p.

A device for cooling liquid metals in atomic nuclear reactors or an installation for simulating the conditions in such reactors is described. The liquid metal is conducted over the exterior surfaces of heat energy conducting pipes and the preferably gaseous cooling medium is conducted through the pipes, the two fluids being thus separately conducted. The pipes are mounted between a pair of parallel end plates and are open at both ends and are surrounded by a cylindrical member. (Official Gazette)

Reactor Fuels

Refer also to abstracts 25349, 25353, 26278, and 26475.

28761 (CNEA-TE-30/123) IRRADIATION TESTING. Herrero, O. D. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 27p. INIS.

The various steps in irradiation testing to determine the behavior of nuclear materials in order to acquire the capacity for the design and fabrication of fuel elements are summarized. The determinations made on the dimensional changes of fuels and claddings, temperature effects, release of fission gases, material compatibility, maximum permissible burnup, thermal conductivity, ratcheting of pellets and claddings, pressure of fission gases, and fabrication variables are described. The characteristics of the two types of experimental devices (capsules and loops) are described and the differences in their concepts and uses are discussed. The calculation of capsules, including the reactor-experiment interrelation, is considered. A list is given of the fabrication techniques used. (INIS)

28762 (FEI-336) METHODOLOGY OF CALCULATION OF OPTIMAL CONSTRUCTION PARAMETERS FOR A STEAM GENERATING CASSETTE FOR A FUEL ELEMENT OF THE CHANNEL TYPE. Kashcheev, V. M.; Yur'ev, Yu. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

A method is proposed for the calculation of the optimum parameters for a steam generating cassette for a fuel element of the channel type. From the conditions set in the upper part of the cassette for steam content and safety factor, the necessary rules for the distribution of the dimensions of the slot channel with respect to the cassette radius are found. The combination of operating factors (power and burnup) at which the optimum is attained for cassette construction is determined. The method can be used for the design of fuel elements of the channel type for reactors with boiling coolants. (tr-auth)

28763 (INIS-mf-1551) FUTURE QUESTIONS CONCERNING FUEL SUPPLIES FOR NUCLEAR POWER PLANTS. Svenke, E. (Norsk Atomenergiforening, Oslo). 1974. 63-93p. (In Swedish). INIS.

A picture is presented on the character of the nuclear fuel industry, size factors, investment requirements, marketing and capacity, as well as future conditions. Although the total requirement for capital investment in the nuclear fuel cycle industry is only about 15% of the corresponding investment in power stations, problems with continued expansion have arisen due partly to the character of the industry and its market, and partly to the economic climate under which the present capacity was established. Establishment of new capacity together with stricter demands on the system of the treatment of high active waste will lead to absolutely increased nuclear fuel costs. This increase is, however, not expected to change the production costs for nuclear power radically, assuming a balanced free market situation. It is important that utilities, industry and authorities in countries with nuclear power interests follow closely the developments in capacity, market freedom, etc., in order to undertake those measures which the situation requires. (INIS)

28764 (JAERI-M-5759) COMPUTER CODE VIBRA-1 FOR ANALYSIS OF THE VIBRATION CHARACTERISTICS OF A BEAM, AND ITS APPLICATION TO A FUEL ASSEMBLY. Murao, Y. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 37p. (In Japanese). Dep. NTIS (US Sales Only).

By survey of the vibration analysis methods available for beams, the modified Myklested method was found to be suitable for analysis of complex beams. Taking the pivot support conditions into consideration, the method was modified, with development of the computer code VIBRA-1. In application of the code to a simple beam, it was found to be capable of calculation from the first to the third mode with accuracy better than 1%. In the fast breeder reactor fuel assembly (FOX-2), the vibration mode and resonant frequency were determined by comparing with the experimental data. The results agreed well with those by the Rayleigh method. (auth)

28765 (JAERI-M-5848) MICROS-2: A COMPUTER PROGRAM FOR PREDICTING THE MECHANICAL BEHAVIORS OF COATED FUEL PARTICLES DURING IRRADIATION (REVISED). Arai, T. (Japan Atomic Energy Research Inst., Tokyo). Sep 1974. 34p. Dep. NTIS (US Sales Only).

The computer program MICROS-2, revised from the original MICROS, is described. It calculates the stress and strain variations in a coated fuel particle and predicts the lifetime of the particle under neutron irradiation. It employs some improved models for physical phenomena occurring during irradiation. Of these, the ones for material behavior are based on the recent experimental results. The mathematical models for stress-strain calculations are then improved to allow for layer debonding and coating fractures in one or more layers. The revised program is written in FORTRAN-4 for computer FACOM 230/60. The machine time is about 100 sec for the analysis of a TRISO-2 type coated fuel particle irradiated to a fast fluence of 8×10^{21} n/cm^2. (auth)

28766 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Leaver, B.; Mercer, W. (to United Kingdom Atomic Energy Authority). British Patent 1,362,562/B/. 7 Aug 1974. Filed date 7 Jul 1971. 5p.

Reference is made to fuel element assemblies of the bundle type, which employ spacer grids to retain the correct lateral location of the fuel pins in the assembly. Such grids must be made to a high degree of precision in order to ensure accurate geometrical spacing of the fuel pins, which makes fabrication expensive. Slight inaccuracies in manufacture may give rise to lateral vibrations of the fuel pins, resulting in surface damage ("fretting"). Wearing pads may be attached to the fuel pins, but this introduces further problems and adds to the expense. The object of the arrangement described is to provide a simple form of spacer grid that does not call for a high degree of accuracy in manufacture and overcomes some of the disadvantages of previous forms of grids. The grid comprises a number of cells formed of metal strip material lying in intersecting planes. The cell walls between the points of intersection comprise pairs of parallel resilient strips that provide resilient lateral support for the fuel pins which penetrate the cells. Stop members are provided to limit displacement due to vibration of the strip when vibration

of the fuel pins occurs. Some alternative constructional arrangements are described. (UK)

28767 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Chetter, J. (to United Kingdom Atomic Energy Authority). British Patent 1,362,681/B/. 7 Aug 1974. Filed date 7 Jul 1971. 9p.

Reference is made to fuel element assemblies of the bundle type, which employ spacer grids to retain the correct lateral location of the fuel pins in the assembly. Provision may be made for resilient bracing of the fuel pins in the grid cells, for example by spring locating members projecting inside the cells so as to hold the fuel pins against stops. The spring locating members are preferably in the form of bow springs extending longitudinally in the cells of the grid structure. The object of the arrangement described is to provide an improved form of bow spring locating member; the improvement relates in particular to the manner in which the bow springs are supported and located within the grid structure. (UK)

28768 ON THE ASYMMETRIC BURN-UP OF SIDE FUEL ELEMENTS AND SPACE DEPENDENCE OF THERMAL UTILIZATION. Ertek, C.; Cakmak, N. (Cekmece Nuclear Research Center, Istanbul (Turkey)). Atomkernenergie; 24: No. 3, 183-186(1974).

The thermal utilization of a 1.143% enriched uranium water moderated lattice has been measured in six different positions including only two fuel element measurements. The fundamental aim of these measurements was first, to see the radial (positional) dependence of thermal utilization, second, to verify the validity of single fuel measurements and third, to compare the theory with experimental results. (auth)

28769 NUCLEAR FUEL ASSEMBLY. Ripley, C. C. (to General Electric Co.). Canadian Patent 957,439. 5 Nov 1974. vp.

A description is given of a fuel assembly containing nuclear fuel rods in spaced array comprising a tubular coolant flow channel and fuel rod spacer assemblies formed of cross-laced beams supported directly by the flow channel. The cross-laced beams serve to provide reinforcement to the flow channel, and may be axially distributed in multiple spaced sections, at least some sections having a transverse spacing interval between adjacent beams to receive at least two rods in adjacent side by side relation, to reduce coolant pressure drop. (CA)

28770 SUPPORTING GRID FOR NUCLEAR FUEL RODS. Kumaoka, Y. (to Tokyo Shibaura Electric Co. Ltd.). Japanese Patent 1973-11265/B/. 26 Oct 1967. 4p. (In Japanese).

A fuel assembly supporting grid is described, which is appreciable in its reduced cross-sectional area, thereby reducing the resistance in the coolant passage, and in its simplicity in production, thereby ensuring that the nuclear reactor will be free from malfunction. The supporting grid includes a cylindrical frame, and a plurality of grid plates arranged at a substantially equal spacing from each other in the longitudinal direction in the cylindrical frame. Each of the grid plates has its side edges secured to the inner wall of the cylindrical frame. Each of the grid plates is formed alternately with flat portions and adjacent semi-circular portions, which in turn are formed with projections. Each adjacent pair of grid plates is formed by the pressing method into a grid plate element, which is composed of symmetrical semi-circular portions and of adjacent symmetrical flat portions. Each symmetrical pair of the semi-circular portions and of the flat portions is made to face each other by folding the grid plate element at its round root portion for symmetry. When the grid plate element is folded, the two facing semi-circular portions will form a circular structure with at least three projections, whereas the two abutting flat portions will form a substantially integral structure having the shape of the capital letter "V". A ring-shaped elastic element is attached to the root of each of the V-shaped integral structures. With these construction arrangements, a nuclear fuel element can be held in each of the circular structures through the projections and the elastic element. (JA)

28771 CERAMIC FUEL PELLETS FOR NUCLEAR REACTORS. Ockert, C. E. (to Energy Research and Development Administration). Norwegian Patent 126,647. 14 Jun 1973. Priority date 18 Nov 1966, USA. 8p. (In Norwegian).

In order to reduce the circumferential stress in the cladding of a fuel pin containing cylindrical ceramic fuel pellets, due to the differential thermal expansion of fuel and cladding, and to fuel swelling, without increasing the fuel cladding clearance, and thereby reducing the thermal conductivity, it is proposed to provide longitudinal slots in the outer surface of the pellets. In the case of a hollow pellet there may also be longitudinal slots on the inner surface. (NO)

28772 OPTIMAL'NOE RASPOLOZHENIE YADERNOGO GORYUCHEGO V REAKTORE. (Optimum Placement of Nuclear Fuels in a Reactor). Rudik, A. P. Moscow; Atomizdat (1974). 68p.

Questions on the optimum placement of nuclear fuels in a reactor were examined. The Pontryagin maximum principle was used. Problems involving calculation of the maximum and minimum reactor power, minimum critical dimensions, and minimum critical mass were solved. (tr-auth)

28773 NUCLEAR FUEL ASSEMBLY. Takigishi, M. (to Power Reactor and Nuclear Fuel Development Corp.). Japanese Patent 1973-18432/B/. 30 Jul 1968. 5p. (In Japanese).

A nuclear fuel assembly is described which contains grids capable of supporting a fuel pin in the correct position and controlling the course of the coolant to effect the pressure loss for equal distribution of the coolant. The fuel assembly is composed of a hexal plane figure of circular bands in succession which are horizontally and vertically disposed and a unit grid plate which has a semi-circular projection at each point of contact with the thus arranged circular bands. The fuel pin is inserted in each circular band and its surface is supported by the uppermost part of the above projection. The central parts are surrounded by six circular bands spirally arranged on the unit grid plates with about a 120° phase difference between each other. The fuel assembly allows the unit grid plate to have a sufficient thickness for bending strength and the fuel pin to have a strong structure free from bending or vibrating on account of the pressure loss of the coolant in the points of contact with the bands. Also it is effective in heat conductance, adding enough resistance to prevent the deviation of coolant flow. (JA)

28774 AUTOMATIC MEASUREMENT DEVICE FOR SPACES BETWEEN FUEL ELEMENTS IN REACTORS. Ishida, R.; Hasegawa, I. (to Sumitomo Electric Industries Ltd.). Japanese Patent 1973-21571/B/. 16 Oct 1968. 5p. (In Japanese).

A description is given of a device for continuous measurement of the spaces formed by fuel elements throughout their entire length. A fuel element moving frame allows a fuel element reserving plate and a fuel element ascending plate to move slowly along an inclined surface. Stoppers in array are designed to stop the fuel movement intermittently. Interlocking with the stopping of the fuel element moving frame, a pressure cylinder actuates a measurement rod. The measuring operation may be done repeatedly. The varied spaces between the fuel elements may be made to correspond correctly to the position of the measurement rod. The intermittent automatic stopping of the fuel element moving plate permits the measurement rod to enter the spaces between the fuel plates, further decreasing the depth of the measurement rod. The apparatus is capable of measuring narrow and deep spaces and obtaining more accurate values by increasing the area of measurement. The automatic operation gives notice of danger due to spacing errors, it allows the measured values to be recorded, and provides input data to a processing unit, thus automatically accomplishing the statistical processing of the spaces formed by the fuel elements, and furthermore providing fundamental data on reactor operation or fuel element management. (JA)

28775 FUEL ASSEMBLY FOR IRRADIATION TEST. Wakasugi, K. (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1973-18431/B/. 15 Feb 1968. 3p. (In Japanese).

A description is given of a fuel assembly for irradiation testing which is easy to assemble and which, at the same time, is capable of reducing coolant flow resistance. A plurality of slender fuel rods is arranged in the longitudinal direction. The terminal edges of the fuel rods are assembled and fixed with a pair of terminal plates. The side surface of the fuel assembly is surrounded by a passage case. Around the central periphery is a plurality of cuts with rail sections at equal distance. A plurality of protruding parts are formed by bending the central line of the cut section to the inside of the said case. A mandrel is connected with the approximate center of a pair of terminal plates. A plurality of cylindrical supporting bodies with a plurality of bending tongue attachments is mounted in the periphery of the mandrel and arranged at approximately equal distance. Thus a side surface of a fuel rod is caught by the bending tongue attachment and the protruding part to keep a plurality of fuel rods at a given distance. The invention allows a fuel assembly to be easily assembled and disassembled. The fuel assembly is capable of reducing the passage resistance of the coolant with a small section area of cut or a plurality of pierced holes. (JA)

28776 FUEL PARTICLE RETAINING FISSION PRODUCTS AND PROCESS OF FABRICATION. (To Commission of the European Communities, Luxembourg). French Patent 2172228/A/. 14 Feb 1973. Priority date 18 Feb 1972, United Kingdom of Great Britain and Northern Ireland. 7p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The fission-product retaining fuel particle consists of a core (lanthanum oxide) surrounded by a fuel oxide (uranium oxide), which in turn is surrounded by an oxide of an element with the atomic number 39, or 57, or 60 to 64 inclusive. The outside coating is pyrolytic carbon which retains the fission products. (tr-FR)

28777 IMPROVEMENTS IN THERMAL ENERGY HIGH POWER ELECTRICAL ENERGY CONVERTERS. Lalaurie, J. (To Thomson-CSF, 75-Paris (France)). French Patent 2177525/A/. 28 Mar 1972. 14p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The thermal energy to electrical energy converter comprises several series-mounted converter members. All these converter members are located in the same tight enclosure, thus with as few brazed connections and insulating ceramics as possible. The emitter of one of these members and the collector of the next member form but one metal part comprising two hollow cylindrical portions, one of which is inserted into the other so as to form a converter member which is heated by a nuclear fuel rod. One pair of independent circuits is used for circulating cesium vapors between the electrodes and the other for pumping the fission products. (FR)

28778 MEASURED AND CALCULATED RATES OF DECAY HEAT IN IRRADIATED ^{235}U, ^{233}U, ^{239}Pu, AND ^{232}Th. Gunst, S. B.; Conway, D. E.; Connor, J. C. (Westinghouse Electric Corp., West Mifflin, PA). Nucl. Sci. Eng.; 56: No. 3, 241-262 (Mar 1975).

Samples of ^{238}U, ^{233}U, ^{239}Pu, and ^{232}Th have been irradiated in high neutron fluxes [$>10^{14}$ n/(cm^2 sec)] and their decay heat has been measured as a function of cooling time ranging from 14 to 4500 h after removal from the high flux. To measure the rate of heat emission, an underwater calorimeter has been developed. For the measured exposure histories, decay heat has also been calculated for concentrations of 190 fission products, all significant heavy isotopes, and structural nuclides. Account is taken of the energy carried by gamma rays that escape the calorimeter. Measurements and calculations of the decay heat captured within the calorimeter agree within two standard deviations for all samples and cooling times and, in general, agree within 2%. For the ^{235}U sample, calculations based on the Proposed ANS Standard ANS-5.1 (ANSI N18.6) agree with the measurements within a few percent. (auth)

Reactor Control Systems

28779 (EUR-4745) EXPERIMENTAL COMPARISON OF Cd AND Hf AS NEUTRON ABSORBERS IN THE CONTROL RODS OF THE HFR AT PETTEN (NETHERLANDS). Haas, D. (Commission of the European Communities, Brussels (Belgium)). 1971. 36p. (In French). INIS.

28780 (EUR-4752) PROPOSAL FOR A CONTROL ROD WITH REMOVABLE FUEL AND POISON SECTIONS FOR THE HFR IN PETTEN. Essler, W.; Conrad, P. (Commission of the European Communities, Brussels (Belgium)). 1971. 38p. INIS.

A demountable control rod is described which consists of a permanent outer AlMgSil housing and removable fuel and poison sections. The fuel section is made up of 18 fuel plates each containing 9 grams of U-235, which are 2.17mm apart. The heat transfer area per plate is 640 cm^2. Hafnium was chosen as absorber, since it is highly effective (strong absorber of epithermal neutrons in certain energy ranges), resists radiation damage, burns out slowly, has adequate mechanical properties, is corrosion-resistant and adequately fabricable. 50% burnup in a neutron flux of 2×10^{14} n/cm^2/sec would be reached after 105 days. The amount of money that could be spared when utilizing the demountable control rod in the HFR is estimated as high as $30000 per year. (INIS)

28781 (FEI-431) DESIGN AND EXPERIMENTAL STUDY OF NEUTRON DETECTOR CHARACTERISTICS "HELIUM COUNTERS IN A MODERATOR". Shapar, A. V.; Efimenko, V. F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 32p. (In Russian). INIS.

A detector for neutron spectrometry utilizing the time-of-flight method is described. The detector consists of 120 SNM-48 helium (^{3}He) counters embedded in a polyethylene block to increase the efficiency of the neutron registration. The working surface area of the detector is 2500 cm^2. The time resolution is 2 μsec. The efficiency for neutron registration in the interval from 30 eV to 200 keV varies smoothly from 10 to 6.3%. (tr-auth)

28782 (GKSS-74/E/38) ON-LINE CALIBRATION OF REACTOR CONTROL RODS BY A PROCESS COMPUTER. Schwieger, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1974. 4p. (In German). INIS.

Published in: Atomkernenergie v. 23(3), 1974 p. 199-202.

The computer code described enables the on-line calibration of reactor control rods. The calibration is based on the rod drive method. The code was written for the process computer TR 86 in order to calibrate the control rods of the FRG-2 in short time. Experimental results are presented. The first operational experiences by the on-line calibration are good. (auth)

28783 (NPS-681108) FFTF CONTROL AND DATA HANDLING SYSTEM DESIGN STUDY. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Feb 1968. 220p. Dep. NTIS $14.00.

The proposed effort represents a balanced approach to the FFTF control and data handling system concept definition. The logical development work plan that has been proposed will be implemented to arrive at an optimum concept for the system. This approach will assist BNWL in final system definition by ensuring that all major trade-offs and considerations that affect system configuration are investigated and tabulated. Key features of the proposed work include: allocation of control and data handling elements to analog and digital (hybrid) mechanization; a logical approach to system definition; documentation of study results; and a recommended final configuration. (auth)

28784 (RN-S-0322) NRX/EST ENGINE CONTROL SYSTEM DYNAMIC TESTING. Final Report. Openshaw, F. L.; Sheridan, E. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1967. 83p. Dep. NTIS $7.25.

The dynamic analysis testing of NRX/EST is described as related to development of the engine control system and an analytical model. A brief description of the test article, primary engine controls systems, and the controls development model are presented. The objectives of dynamic testing are discussed and test results summarized. Analytical steps leading to the choice of controller compensations are described and test data are compared to analytically predicted responses. The report concludes that, after modification, the controllers operated satisfactorily throughout EST testing and that there was good correlation between analytical models and test results for the kinetics portion of the common analog model (CAM). The report recommends further data evaluation of the pressure system, investigation of internal feedbacks, and re-evaluation of the basic model equations and curve fits. It is also recognized that model improvements are required because of gain and phase discrepancies in temperature response between CAM and EST test data. (auth)

28785 (RN-S-0450(Rev.1)(Part 4)) HANDBOOK OF OPERATING AND MAINTENANCE INSTRUCTIONS FOR XE-PRIME ENGINE CONTROL SYSTEM. Revision 1, Part IV. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1969. 35p. Dep. NTIS $4.75.

28786 (RN-S-0450(Rev.1A)) HANDBOOK OF OPERATING AND MAINTENANCE INSTRUCTIONS FOR XE-PRIME ENGINE CONTROL SYSTEM. Revision 1A. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1969. 112p. Dep. NTIS $8.75.

The purpose of this handbook is to provide a current source of operation and maintenance information concerning the XE-Prime Engine Control System (ECS). A complete cross reference to all ECS chassis by rack and console number to AGC (Operation and Maintenance) handbooks is presented. Supplemental or replacement pages will be supplied as necessary. (auth)

28787 (RN-S-0537) XE-ENGINE TSCS/ECS SYSTEM DESCRIPTION. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1970. 113p. Dep. NTIS $8.75.

The functional and operational characteristics of the Test Stand Control System and Engine Control system used to control and test the XE-Prime Engine are described. The design and development of the equipment was a joint effort by Aerojet-General and the Westinghouse Astronuclear Laboratory. The configuration and purpose of the control systems is presented, with brief discussions and illustrations of each of the eight major subsystems. (auth)

28788 (TID-7653-P2(P1 and 2), pp 120-127) CONTROL SYSTEMS FOR A LIQUID-HYDROGEN-COOLED KIWI-B REACTOR. Blake, P. J.; Bohl, R. J.; Brown, E. A.; Milich, C. P.; Nutter, M. J.; Stiles, C. E.; Strait, B. G. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

Systems developed for controlling power, temperature, turbopump speed, and flow rate in the liquid-H_2-cooled Kiwi-B-1B

reactor are reviewed. The operation of these systems in a power test of the reactor is discussed. (TSS)

28789 (TID-7653-P2(P1 and 2), pp 144-153) SUMMARY OF NUCLEAR RADIATION HEATING ANALYSIS AND COOLING SYSTEM DESIGN OF A KIWI-B PROTOTYPE ROTARY ELECTRO-PNEUMATIC CONTROL ACTUATOR. Edmond, J. J. (Bendix Corp., Southfield, MI). 1962.

In proceedings of nuclear propulsion conference.

Radiation heating rate measurements were made for the prototype actuator based on the Kiwi-B anticipated radiation intensity of 1000-Mw reactor power. Forced gas convection, using a portion of the hydrogen propellant, was used as the basic heat transfer mechanism of the cooling system. Results of the studies are presented graphically. (TSS)

28790 (TID-7653-P2(P1 and 2), pp 154-162) KIWI-B-1A POWER AND TEMPERATURE CONTROL SYSTEMS. Brown, E. A.; Demuth, H. B.; Erickson, P. B.; Mohler, R. R.; Singer, S. J.; Stiles, C. E. (Los Alamos Scientific Lab., NM). 1962.

In proceedings of nuclear propulsion conference.

The design and performance of the power and temperature control systems in the Kiwi-B-1A rocket reactor are reviewed. (TSS)

28791 (TID-7653-P2(P1 and 2), pp 546-557) AN APPROACH TO STARTUP CONTROL OF A NUCLEAR ROCKET ENGINE. Searle, R. F.; Marcy, R. D. (Rocketdyne, Canoga Park, CA). 1962.

In proceedings of nuclear propulsion conference.

Transient performance and control are important in the analysis and design of a nuclear rocket engine. When specifying the control system, the design and safety features associated with nuclear reactors must be considered in conjunction with performance requirements common to rocket propulsion systems. An analysis is made of the startup problems and control requirements for an upper-stage nuclear rocket propulsion system in the 1500 megawatt class. (TSS)

28792 (TID/SNA-166) STATUS OF PHOEBUS CONVECTIVELY COOLED NOZZLE CONTROL SYSTEM DESIGN. Langill, A. W. Jr. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 May 1967. 274p. Dep. NTIS $16.75.

The preliminary Phoebus nozzle control system was optimized in accordance with data obtained from cold flow testing. Due to the incident that occurred during Run 1.2-15-NNN-005, and the subsequent re-evaluation of fail-safe protection modes and start sequencing procedures, a series of modifications were made to the overall control system. The existing control system is described and the current status of the optimized design and analysis model is presented. (auth)

28793 (TID/SNA-321) I AND C ANALYSIS REPORT ON ENGINE CONTROLLABILITY (NJD-0026). Saluja, J. K. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 130p. Dep. NTIS $9.50.

The results of the analysis on engine controllability are for the Normal Operating Range, i.e., thrust buildup through pump tailoff including steady state operation, throttling, throttle hold, and temperature retreat. The analysis was performed on the E-1 CAM model in support of NSS PDR. This model does not yet include the pump discharge control valve. It will be incorporated in subsequent controllability analysis for engine PDR and it is expected that the results will change significantly, although the engine characteristics around the design point will be essentially the same. The engine model shows regions of static instability at various points on the operating map. All transient requirements for one-TPA operation are met, whereas, for normal mode operation present chamber pressure tolerances during the transient are not met. For throttling transients and for normal mode operation, all controllability requirements have been met, whereas, for one-TPA operation, chamber pressure error was high. This was due to the fact that the pressure-controller gain was not readjusted. The analog controllers have been digitized and the performance for the high Isp startup transient appears quite good. Static stability of the engine is discussed and it is concluded that the addition of the in-line pump discharge control valve would have a stabilizing influence on the model. In general, for all transients considered, chamber temperature errors were higher for the End of Life case than for the Start of Life case. It is concluded that all controllability requirements specified can be met in all phases of Normal Operating Range Control (NORC) operation (including certain malfunctions) and the engine can be considered controllable to within the presently defined tolerances. (auth)

28794 (TID/SNA-702) PROGRAM PLAN FOR DEVELOPMENT OF THE INSTRUMENTATION AND CONTROL (I AND C) SYSTEM FOR THE NERVA ENGINE. Volume II. Appendices. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jan 1970. 155p. Dep. NTIS $10.75.

The I&C system performance requirements are described in detail in the following categories: engine controls; malfunction detection and corrective action; engine and nuclear subsystem measurements; engine measurement signal processing; electrical power source, conditioning and distribution; engine electrical signal transmission; and vehicle/stage interface compatibility. Drawings are listed and described. (auth)

28795 (TID/SNA-742) INSTRUMENTATION AND CONTROLS REQUIREMENTS. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Aug 1969. 40p. Dep. NTIS $5.00.

Requirements for instrumentation and control systems during startup, steady-state operation, shutdown, and cooldown of the NERVA engine are presented. (JWR)

28796 (TID/SNA-948) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Instrumentation and Control Subsystem. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 17 Jul 1970. 147p. Dep. NTIS $10.50.

28797 (TID/SNW-2) ROVER FLIGHT SAFETY PROGRAM PRELIMINARY REVIEW. Volume III. Part A. Program Report on the Anti-Criticality Poison Wire System. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Sep 1965. 85p. Dep. NTIS $7.25.

The status of the development program for the Anti-Criticality Poison Wire System (ACPS) is reported. The present program reflects the contribution of the Safeguards Engineering Department of the Westinghouse Astronuclear Laboratory. The need for an in-flight poison wire system for maintaining the NERVA reactor sub-critical from assembly to operation in space was realized early in the NERVA program. A developmental effort in the area has been pursued since 1962. At the present time, a shipping type of poison wire is in use. However its use for space operation is limited due to material rigidity, excessive weight and neutronic values. It was therefore necessary to develop a flexible poison wire capable of being extracted from the reactor core and through the nozzle throat for system storage or ejection. The system design is based on criteria derived from normal and accidental environmental conditions which might conceivably be encountered during assembly and space flight. In addition to listing the criteria upon which the ACPS system is based, a description of the entire system, operational sequences and control features are provided. Reliability has been stressed and is reflected in the conceptual design of each component. Problems of hardware availability, manufacturing technique and material selection have been substantially resolved. Fabrication and successful testing of key sections of the ACPS have been accomplished. It is anticipated that a preliminary model will be available to demonstrate reliability and successful mechanical operation on a NERVA reactor in the near future. (auth)

28798 (WANL-TME-1984) CONTROL DRUM ACTUATOR. Trade Study No. 754. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1970. 407p. Dep. NTIS $23.50.

28799 PRESSURIZED FUEL ELEMENT. Ferrari, H. M. (to Westinghouse Electric Corp.). Canadian Patent 950,134. 25 Jun 1974.

A metallic clad sealed fuel element for a nuclear reactor is internally pressurized to resist creep collapse in the early stage of burnup. The fuel element has a normally sealed plenum chamber which is rupturable when a predetermined increased pressure is reached during burnup to provide a void space for fission gases. (auth)

28800 THERMAL SWITCH-HEAT PIPE. Gregorie, K. E.; Pfefferlen, H C. (to United States Atomic Energy Commission). US Patent 3,854,524. 17 Dec 1974. Filed date 7 Sep 1972. 6p.

A radial heat pipe is fitted with a wick and working fluid for the temperature of interest and operated in such a manner as to act as a thermal switch. The heat pipe surrounds nuclear fuel elements and during normal temperature operation transports negligible energy but upon a surge in fuel element temperature large amounts of heat can be transported to limit the fuel element temperature. (Official Gazette)

28801 REACTOR MEGAWATT DEMAND SETTER. Caruso, R. M.; Musick, C. R. (to Combustion Engineering Inc.). US Patent 3,849,637. 19 Nov 1974. Filed date 22 May 1973. 12p.

A description is given of an on-line control device which permits the nuclear powered generating unit to operate at maximum permissible power for the existing nuclear steam supply system conditions by exercising control over the unit turbine in such a manner that the rate of load change will be controlled as a function of the proximity of the actual load to the desired load and the rate of load increase will be algebraically limited by the proximity of the

nuclear steam supply system conditions to the steam supply system operating limits. Additionally the turbine load will automatically be reduced when necessary at a rate which equals or exceeds a value which is commensurate with the magnitude of any violation of the steam supply system operating limits. (Official Gazette)

28802 ANALYSIS OF IN-CORE FLUX AND TEMPERATURE DATA FOR THE EVALUATION OF THE PERFORMANCE OF AN OPERATING REACTOR. Fenech, H. (Univ. of California, Santa Barbara); Flournoy, W. G.; Shen, P. K. Ann. Nucl. Sci. Eng.; 1: No. 6, 383-395(Jun 1974).

A method of analysis of in-core flux measurements for nuclear reactors is presented. By appropriate data processing, the method determines separately the statistical and deterministic errors present in the measurement. Those errors are carried throughout the analysis for determination of the local power produced, the nuclear hot channel factor and the DNB ratio with a required confidence level. An application of the method is given using the flux measurement data obtained for the first core cycle at San Onofre Unit 1. In addition, the method is extended to the processing of the recorded data from in-core thermocouples to obtain the engineering hot channel factors and the coolant by-pass fraction. (auth)

28803 FLUCTUATION TYPE POWER AND PERIOD METER FOR NUCLEAR REACTOR. Sapozhnikov, A. I.; Kazachkov, V. I. Sov. At. Energy (Engl. Transl.); 36: No. 3, 266-267(Mar 1974).

Translated from At. Energ. (USSR); 36: No. 3, 215-216(Mar 1974).

A description is given of an instrument designed to measure the neutron flux density and the reactor period T on the basis of the variance of ionization chamber current. The fluctuation component of the ionization chamber signal is amplified and is fed to a function generator in which the signal proportional to the neutron flux is separated out and its logarithm is taken. A signal from a differential amplifier is obtained which is proportional to the reciprocal of the reactor period. (auth)

28804 PERIOD-SCRAM RELEASING SYSTEM FOR A NUCLEAR REACTOR UNDER HIGH OUTPUT OPERATION. Furukawa, T.; Wakayama, N. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973-11271/B/. 16 Aug 1965. 3p. (In Japanese).

A period-scram releasing system is described which is used in a nuclear reactor under high output operation. A logarithmic amplifier and a period meter are incorporated in the period-scram releasing system, and are electrically connected via a clamping circuit which is operative to maintain the output level of the logarithmic amplifier at a predetermined value when the particular output level exceeds the predetermined value. Thus, the input level of the period meter is accordingly maintained at the predetermined value when the nuclear reactor is running in high output operation, so that the output level of the period meter will not exceed the tripping level. The nuclear reactor equipped with the present period-scram releasing system will have the tripping factors due to the period meter excluded from its own tripping factors. (JA)

28805 NUCLEAR REACTOR. Doi, A.; Inoue, K. (to Hitachi Ltd.). Japanese Patent 1973-11270/B/. 17 Apr 1967. 3p. (In Japanese).

A nuclear reactor is described in which a water-soluble control material is dissolved in the cooling water as an auxiliary control means. The concentration of the control material can be rapidly, automatically, and continuously measured by adopting a second material with the control material in the cooling water. This second material is, for example, boric acid, sulfuric acid, or phosphoric acid, and exhibits a behavior similar to the control material toward an anion-exchange resin. The second material has a large degree of ionic dissociation and a large ion mobility. Thus, the concentration of the control material can be obtained in terms of that corresponding concentration of the second material which is electrochemically measured. (JA)

28806 COMPOSITE AMPLIFIER FOR REACTOR INSTRUMENTATION. Furukawa, T.; Wakayama, N. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973-11269/B/. 10 Jul 1965. 5p. (In Japanese).

A description is given of a composite amplifier for the neutron instrumentation of a nuclear reactor, said amplifier being accomplished with the use of two amplifiers. The amplifier includes a voltmeter amplifier and a serial circuit connected in parallel with the voltmeter amplifier and composed of a logarithmic diode and a resistor. The composite amplifier is operative when in the low input range of electric current to generate an output voltage in proportion to the logarithm of the input, and, when in the high input range of electric current, to generate an output voltage which is produced by superposing a voltage proportional to the high input upon the output voltage for the low input range. In a modification, the composite amplifier further includes a differential circuit connected with the voltmeter amplifier for receiving an output of the same. The composite amplifier thus modified is, on the other hand, operative to act as a period meter in the low input range and to act as a grade meter for the increasing output in the high input range. (JA)

28807 A DEVICE FOR DRIVING THE CONTROL MEMBERS OF A NUCLEAR REACTOR. Maslenok, B. A.; Khegai, A. S.; Zlobin, V. G.; Mednitsky, V. G.; Genkin, L. I.; Petrichenko, N. F.; Mitrofanov, B. I. French Patent 2178783/A/. 6 Apr 1972. 7p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The drive is characteristic in that the device to prevent the spontaneous displacement of the reactor control rod in the lower part of a tight reactor shell is a piston resting on the support surface of the annular chamber located in the lower part of the shell and whose upper part has a conical surface immobilizing the rod by wedges. The lower part is pierced by channels assuring communication with the reactor core. The control rod is enclosed by a tube arranged coaxially to the piston. (tr-FR)

Nuclear Power Plant Economics

28808 (CNEA-370) OPTIMUM REACTOR TYPE STRATEGIES. Solanilla, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 24p. (In Spanish). Dep. NTIS (US Sales Only) $4.25.

A computer code based on operational research is applied to study the problem of along term optimum reactor strategies. (auth)

28809 (IAEA-R-1045-F) ECONOMIC COMPARISON OF NUCLEAR REACTORS OF 350 AND 450 MW(e) FOR DEVELOPING COUNTRIES. Final Report for the Period 1 September 1971-31 August 1973. Aybers, N.; Kakac, S.; Bayulken, A.; Gencey, S. (International Atomic Energy Agency, Vienna (Austria)). Sep 1973. 189p. INIS.

The study is focused on the determination of the various costs of nuclear power plants and the relationship to local conditions prevailing in developing countries. Turkey is taken as an example and reactor sizes of 350 and 500 MW(e) are considered. The ground rules for the economic evaluation of power projects are established and modified by local factors. In sequence, the capital costs, the fuel cycle cost, the operating and maintenance costs and the total cost of electricity are calculated and discussed for 350 and 500 MW(e) PWR's. Detailed breakdown of costs are given and economy of scale exponents are developed for the capital cost component. Escalation and interest during construction are carefully considered. Fuel cycle calculations are done for the regime core and the first core. Transportation cost is found to be a major cost component of the fuel cycle when the country is distant (4000-7000 miles) from reprocessing plants. Also, local fabrication of fuel is studied. (INIS)

28810 (INIS-mf-1486) TASK FORCE HYDRO: REPORT NUMBER THREE. Nuclear Power in Ontario. (Committee on Government Productivity, Toronto, Ontario (Canada)). Feb 1973. 70p. INIS.

Results of an investigation and recommendations regarding the role of nuclear power in the province of Ontario are presented. A brief summary of the basic characteristics of CANDU (Canada Deuterium Uranium) power systems is followed by a more detailed analysis of the program including brief comments on foreign assessments of CANDU. The viability of Canadian reactors is discussed with respect to issues such as reliability, environmental quality, cost, and unit energy costs. Consideration is also taken of future uranium and heavy water supply. (INIS)

28811 (LA-5795-C, pp 9-14) INCENTIVES FOR NUCLEAR PROCESS HEAT APPLICATIONS IN INDUSTRY. Decker, G. L. (Dow Chemical Co., Midland, MI); Bonham, E. A. Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

The basic motivation for considering industrial use of nuclear heat is two-fold, a matter of supply and of economics. The existing imbalance between demand for oil and gas and domestic supplies shows every indication of continuing indefinitely, and the time and effort required to solve the many problems associated with exploiting our coal resources are considerable. In addition, price projections indicate that energy from nuclear

reactors, at least in some forms, is potentially cheaper than energy derived from fossil fuels. The present state of technology indicates that small reactors sized to service typical industrial energy loads are not economically attractive. The most viable alternative appears to be the furnishing of by-product steam from a neighboring nuclear central power station, the "energy center" or "industrial park" concept. The major economic attraction, in addition to nuclear reactor costs, is the fact that much of the heat taken and utilized by industry would otherwise have to be rejected to the environment via expensive cooling ponds and towers. The advent of the HTGCR should further extend the range of possible industrial applications. (auth)

28812 (LA-5795-C, pp 24-28) NUCLEAR REACTOR PROCESS HEAT CAPABILITIES, POTENTIAL, AND ECONOMICS. Trauger, D. B. (Oak Ridge National Lab., TN); Bennett, L. L.; Bowers, H. I. Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Nuclear reactors are well-established as an economical energy source for electrical power generation, and nuclear energy is projected to contribute 70% of the energy used for generating electricity in the year 2000. While this is a significant contribution by nuclear energy to the Nation's energy needs, the non-electric or industrial sector is an even larger energy user which is yet to be served by nuclear energy. A present-day limitation of nuclear power plants is that they are all steam producers, whereas many industries need high-temperature process heat in addition to steam. The higher temperature energy presently supplied by oil and gas cannot be met by existing reactor designs. However, with slight modifications, the General Atomic Company's HTGR can reach core outlet temperatures of 870-980°C (1600-1800°F). The German pebble-bed reactor is reported capable of reaching core outlet temperatures as high as 1150°C (2100°F). Achievement of these temperature capabilities would allow the gas-cooled reactors to supply process heat as well as industrial steam requirements. Additional research will be needed on reactor design and materials for operation at such high temperatures. The cost of steam from nuclear reactors for industrial uses has been evaluated. Nuclear energy costs have been compared with coal or refined-coal fuels at a U. S. Gulf Coast location. These studies indicate that, in large sizes, the LWR and HTGR can provide process steam at lower cost than coal-based plants. While the CNSG is smaller than conventional LWRs, and therefore a more appropriate size for many industrial applications, the unit energy cost is significantly higher than from larger nuclear plants (due to economies of scale) or from a variety of coal fuel cycles. (auth)

28813 (LA-5795-C, pp 29-32) OVERVIEW OF REACTOR APPLICATIONS FOR LOW-TEMPERATURE INDUSTRIAL PROCESS HEAT USES. Spiewak, I.; Anderson, T. D. (Oak Ridge National Lab., TN). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

The industrial sector is the largest energy user in the United States, accounting for over 40 percent of the total primary energy consumed. The "low-temperature process heat" or industrial steam consumption alone is about 17 percent of the total national energy use. An Oak Ridge National Laboratory (ORNL) survey identified the paper, chemical process and petroleum refining industries as industries which might potentially benefit from steam from nuclear power plants. A comparative assessment of energy options based on coal and nuclear systems was made by a study team composed of ORNL staff members and participants from those industries. The assessment indicated that the most economical steam source would be large dual-purpose nuclear power plants supplying both steam and electric power. However, only the largest refineries or chemical complexes can use the output of one reactor. Small, special-purpose reactors appear to have attractive characteristics, although their steam costs are much higher than those from larger commercial power reactors. (auth)

28814 (LA-5795-C, pp 33-38) OVERVIEW OF REACTOR APPLICATIONS FOR HIGH TEMPERATURE. Balcomb, J. D. (Los Alamos Scientific Lab., NM). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Recent developments creating new interest in nuclear process heat applications are reviewed. Economic considerations are examined and high temperature process applications are discussed. These applications include nuclear steelmaking, coal gasification, and thermochemical cycles. (JWR)

28815 (LA-5795-C, pp 39-44) NUCLEAR-INDUSTRIAL COMPLEXES. Hammond, R. P. (R and D Associates, Santa Monica, CA). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

A nuclear powered industrial complex is a natural and efficient extension of the nuclear power park concept. By on-site use of a large part of the energy produced, major costs of transmission and transformation of energy are saved and much ecological impact of separate industrial installations can be avoided. Such complexes should become a common phenomenon as the nuclear age develops. They can be located on land near a large metropolitan region, or offshore on large floating islands. A probable size for a single complex at maturity would be 50 million kW thermal output, 15 used as industrial process heat, 4 as electricity used on site, and 6 transmitted elsewhere. The annual cash flow from such a complex would be in the range of $3-5 billion for energy production, and up to $100 billion overall. The normal rate of growth of the nation's energy supply would be equivalent to the construction of such a complex every six months. (auth)

28816 (LA-5795-C, pp 55-61) UTILITY/PROCESS INDUSTRY CONSIDERATIONS FOR NUCLEAR PROCESS HEAT FACILITIES. Law, S. H.; Holm, J. L. (Northeast Utilities, Hartford). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Industries that might make use of nuclear process heat should give careful consideration to working jointly with the local electric utility. Several reasons for this suggestion are discussed. As an example, the electric utility industry has more experience in the planning, licensing, construction, and operation of a nuclear plant than any other industry. There may also be economic incentives for the joint utilization of such a plant. While there are at present many unresolved legal, economic, financial, and regulatory questions surrounding the concept of joint ventures with an electric utility, it may be assumed that this type of arrangement could be shown to be in the public interest and that those questions might be resolved in a reasonable period of time. (auth)

28817 (LA-5795-C, pp 70-86) ENVIRONMENTAL AND RESOURCE CONSERVATION ASPECTS OF NUCLEAR PROCESS HEAT APPLICATIONS. Gage, S. J.; Clark, E. H. II; Singer, M. I. (Council on Environmental Quality, Washington, DC). Nov 1974.

From 1st national topical meeting on nuclear process heat applications; Los Alamos, New Mexico, USA (1 Oct 1974).

In proceedings of the first national topical meeting on nuclear process heat applications.

Oil Supply contraints and high energy prices, triggered by the international oil embargo last winter, have created economic incentives for the development of energy conserving measures and for the search for alternative energy systems for future application. Such alternatives have implications both for conservation of energy and other resources and for environmental protection. Environmental impacts of energy systems are discussed with particular attention to coal gasification. Two approaches, one conventional (Lurgi) and one under development (using a high temperature gas cooled reactor to produce the required process heat) are examined. A methodology and some tools being developed by the President's Council on Environmental Quality for quantifying environmental impacts of energy alternatives are also discussed. The importance of looking at both direct and indirect impacts for entire systems is stressed. (auth)

28818 (PB-233229) CONCEPTUAL DESIGN STUDY OF A 200 MILLION GALLON PER DAY VTE-MSF DESALINATION PLANT AND PROTOTYPE MODULE. Research and Development Progress Report. Cane, D.; Giorgione, D. M.; Keen, J. W.; Moen, D. L.; Nalbone, R. L. (Westinghouse Electric Corp., Lester, Pa. (USA). Steam Div.). Oct 1970. Contract DI-14-30-2700. 240p. (INT-OSW-RDPR-74-972). NTIS $15.00.

On April 1970 Westinghouse Electric Corporation was awarded one of four study contracts from the Office of Saline Water (OSW) with Burns and Roe, Inc., as the other member of the Manufacturer-Architect/Engineer team to prepare conceptual designs for a 200 Mgd (million gallons per day) sea water distillation plant, as well as a conceptual design for a prototype/module which, when built, would demonstrate the feasibility of the 200 Mgd plant. (GRA)

28819 NUCLEAR ENERGY. Mooradian, A. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Chem. Can.; 26: No. 10, 25-27(Nov 1974).

Nuclear energy is expected to play an ever increasing part in its contribution to Canada's energy needs. Presently, 11,200 MW(e) of nuclear capacity is either operating, under construction, or committed. While nuclear energy now contributes only 2% to Canada's total energy requirements, this is expected to rise to about 20% by the year 2000. The nuclear reactor system of choice for Canada seems to be the Candu system because of the abundance of natural U in Canada. (auth)

28820 NUCLEAR POWER IN THE WORLD. Quihillalt, O. A. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). Publ. Energ.; 1: No. 1, 21-26(Mar 1973). (In Spanish).

The world evolution of installed nuclear power stations or nuclear power stations in the first operational steps, under construction, planned, and contemplated, with no more doubt on their economic and technical competitiveness, is outlined. The following topics are discussed in the form of graphs and statistics: world evolution of installed nuclear power from 1960 to 2000; evolution of nuclear reactors from 1957 to 1978; reactors in operation in 1978; principal types of reactors; types of reactors in operation or under construction; world stock of natural and enriched U; world stock of heavy water; international treaties. The national policies fixed by the government on the nuclear development of the country are considered. (INIS)

28821 WHAT IS THE COST OF THE NUCLEAR POWER. Osla, B. J. (Comision Nacional de Energie Atomica, Buenos Aires, Argentina). Argent. Electroenerg.; 1: No. 1, 5-11(Jun 1973). (In Spanish).

The conditions making it possible to evaluate accurately the cost of a nuclear power plant and thus the cost of kWh generated are analyzed. The costs of the nuclear power plant at Atucha and at Cordova are given. In the case of the latter it is estimated at 450/kW in US dollars for the installation cost and 0.094/kWh in pesos for the generation, considering certain conditions such as the value of dollars in April 1975, useful life of 39 years without reprocessing, and use of a unified charge. (INIS)

28822 NUCLEAR ELECTRIC POWER: DO WE NEED IT AND HOW SHOULD WE DECIDE. Gofman, J. W. (Univ. of California, Livermore). pp 69-89 of Energy and the Environment. Efford, I. E. (ed.). Vancouver, B. C.; Univ. of British Columbia (1972).

Proposals are put forward to create a separation of powers between the utilities and their regulatory agencies. Once the true extent of the national need for additional energy is determined, it remains to be solved which power generation methods should be used. Seven fundamental principles are proposed to aid in making this choice, these principles having to do with safety, environmental impact, and renewability or abundance of fuel sources. Solar energy and nuclear power are examined by these criteria. (CA)

28823 2,300 MW OFFSHORE NUCLEAR POWER PLANT PROJECT. Gitlevich, A. D. Ekspress-Inform., Stroit. Tepl. Elektrosta.; No. 4, 18-20(1973). (In Russian).

A project is under way for locating a nuclear power station in the open sea, on two floating platforms 122 × 116 meters and with water displacement of 126 thousand tons. The platforms will be moored several kilometers from the shore and will be protected from waves. Underwater cables will connect the station to shore substations. The reactor shield will be provided with ice condensers. Work is scheduled to begin in 1975, with installation in the sea in 1980. The cost will be 10^9, including a $250 million breakwater. This type of installation will eliminate the need for large parcels of land. Considerable difficulties will be encountered in constructing the floating nuclear power station. (tr-auth)

28824 KJERNEKRAFT OG ANNEN ENERGI. En bok om Energibehov, Ressurser, og Varmekraftspoersmaal. (Nuclear Power and Other Energy. A Book on Energy Needs, Resources, and Thermal Power). Oslo; Groendahl and Soen (1974). 142p.

A discussion of energy sources, reserves, consumption, and optimization is followed by an evaluation of these factors in Norway's energy situation. It is concluded that thermal power will be required in the near future, and that this should be nuclear power. The basis of nuclear reactor technology is explained at an elementary level, and radiation hazards, radiation protection, reactor safety, and accidents are discussed. The treatment and disposal of radioactive waste is presented, and the possible misuse of plutonium and safeguards against such misuse are discussed. The nuclear controversy is summarized, and nuclear power programmes in other countries briefly examined. The main arguments in favor of the utilization of nuclear power are given. (NO)

28825 THREE ENERGIES FOR THE XXI CENTURY. Gibrat, R. (Societe pour l'Industrie Atomique, Paris). Sci. Avenir; No. 12, 12-19(1974). (In French).

It is shown that in addition to energy produced by breeder and high temperature reactors, it is principally geothermal, solar, and nuclear fusion energies that can meet the envisaged five-fold increase in the demand for energy. (FR)

28826 SYSTEMS OF HEAT SUPPLY WITH ATOMIC HEAT SOURCES. Sukhov, A. B.; Kovylyanskii, Ya. A.; Gurevich, L. V. Elek. Sta.; No. 9, 37-41(1974). (In Russian).

The technical level achieved in atomic power engineering permits examining the question of utilization of nuclear fuel in systems of heat supply. By comparative analysis of the various types of reactors the authors were able to prove that atomic thermoelectric power plants with gas-graphite reactors answer all requirements imposed by systems of heat supply on heat sources and that they are the most economical. However, since the Soviet Union has as yet been unable to master reactors of this type, the authors recommend using pressurized water reactors and boiling water reactors at the atomic thermoelectric power plants. For the atomic boilers they also propose using pressurized water reactors. They suggest a new method of selecting the optimal variant of a system of heat supply by taking into account the system as a whole. On the basis of a computer analysis of the various heat supply systems, the authors concluded that heat supply systems with nuclear heat sources under the conditions of the European part of the USSR will be feasible, beginning with heat loads of 1000 Gcal/hour and higher: atomic boilers in the range of heat loads from 1000 Gcal/hour to 1500 Gcal/hour, and the atomic thermoelectric power plants with heat loads above 1500 Gcal/hour. (JPRS)

28827 ENERGY ANALYSIS OF NUCLEAR POWER. Wright, J.; Syrett, J. (Central Electricity Generating Board, London). New Sci.; 65: No. 931, 66-67(9 Jan 1975).

An answer is given to published claims that the overall energy balance between energy investment required to build nuclear power stations and to obtain their fuel and that recovered from the power station operation takes many years to reach a break-even time. It is shown that an energy analysis is more meaningful if the thermal energy (rather than electrical) output of the nuclear power station is compared with the thermal energy devoted to its construction. If such a method of calculation is adopted an acceptable break-even time is obtained, and the case for building nuclear power stations to conserve precious fossil fuel is overwhelmingly clear. (UK)

28828 COST ECONOMICS OF NUCLEAR POWER PLANTS IN THE US. Akhtar, M. S. J. Inst. Nucl. Eng.; 15: No. 5, 144-151(Sep 1974).

It is stated that the USA, with 5.77% of the world's population, consumes 34% of the world's energy, although this is expected to decrease to about 27% by 1983, with faster consumption by other countries. Cost economics of nuclear power in the USA are reviewed under the following headings: plant costs; direct capital costs (basic costs; steam supply system equipment costs; turbine, generator and condensing equipment costs; site materials costs; site erection labor costs); indirect capital costs (engineering design and construction supervision costs; fixed capital charges); operational and maintenance costs; nuclear fuel management; nuclear fuel economics; costly delays due to licensing implementations; costs due to environmental limitations; insurance costs; escalation of costs; major causes of cost increase; construction delays; and future cost projections. (UK)

28829 NUCLEAR POWER PLANTS IN THE NORTH SEA. Taurit, R. (Staatliche Fachhochschule Luebeck fuer Technik und Seefahrt (F.R. Germany)); Franzen, R. Atomwirt., Atomtech.; 19: No. 12, 586-589(Dec 1974). (In German).

3 figs.; 4 tabs.; 10 refs.

A study of the possibilities and limits related to the construction of floating nuclear power plant isles in coastal waters of the German Federal Republic is discussed. Locations near the mouth of rivers would be favorable for floating power plant isles. Considering the main site-specific results of the study, there are two sites distinguishing themselves for the construction of such isles. The economic disadvantages of about 30% in electric power generation costs could be justified in case of lack of sites inside the country. (auth)

28830 ENERGY POLICY BETWEEN STRUCTURE POLICY AND REGIONAL PLANNING POLICY. Arens, H. J. Energiewirt. Tagesfragen; 24: No. 10, 495-499(Oct 1974). (In German).

19 refs.

Following a description of the contents of energy policy and structure and regional planning policy, their aims, aim conflicts, and possibilities of solution are explained. The reciprocal influences are described. The factors influencing the distribution of economic electric power plants are described as well as optimum solutions being suggested. (GE)

28831 TRENDS OF DEVELOPMENT IN POWER-HEAT COMBINATION WITH REFERENCE TO DISTRICT HEATING. Hedbaeck, T. VGB Kraftwerkstechnik; 54: No. 11, 708-714(Nov 1974). (In German).

16 figs.

Heat-Power combination is about 25 years old in Sweden. Small back pressure turbo-generator units have, however, become too expensive for this specific purpose and, therefore, the power combination of gas turbines and diesel engines is interesting for the small capacities. To meet larger scale heating requirements conventional 250 MW heating turbo-generators are normally installed. Nuclear power stations of 500 MW or 2,000 MW capacity are being studied for this purpose for the Stockholm area. (auth)

28832 BREAKDOWN OF NUCLEAR POWER PLANTS AS A POWER ECONOMIC PROBLEM. Maerzendorfer, H. Energiewirt. Tagesfragen; 24: No. 10, 476-482(Oct 1974). (In German).

2 figs.; 6 refs.

Following a survey of the main problems, the foliowing topics are dealt with: demands of the transport pipes, fast nuclear power reserves, maintained failure reserves, reserve conditions in closed interconnected system, reserve furnishing by gas turbines, and cooperation and power plant reserves of Austrian electric power producers. (GE)

28833 PRESENT STATE AND DEVELOPMENT PROSPECTS OF THE POWER ECONOMY OF FINLAND. Solotow, O. I. Arch. Energiewirt.; 28: No. 19, 927-935(Oct 1974). (In German).

3 figs.; 7 tabs.; 11 refs. Translated from Energochozjajstvo za rubezom (No. 3) 1974, p. 38-42.

The development and structure of the power economy from 1951 onwards is described. Besides petroleum, hydraulic power plays an important role as a primary energy source. The energy demand predictions go up to 1990. Particular component of the future energy production are 10 nuclear power plant units which are to be built by 1990. (GE)

28834 ELECTRICITY SUPPLY AND POWER PLANT PLANNING IN THE CSSR. Peer, V. A. Energiewirt. Tagesfragen; 24: No. 10, 501-502(Oct 1974). (In German).

4 tabs.

A survey is presented of the present state of development, and projections are made for development up to the year 1990. (GE)

28835 OPERATIONAL EXPERIENCES WITH GERMAN NUCLEAR POWER PLANTS IN 1973. P. 2. Atomwirt., Atomtech.; 19: No. 11, 551-554(Nov 1974). (In German).

28836 NUCLEAR PROGRAM IN FINLAND. Com. Naz. Energ. Nucl., Notiz.; 20: No. 12, 58-59(Dec 1974). (In Italian).

A brief review of the current status of Finland's nuclear power program is presented. (auth)

28837 TOWARDS THE PREDOMINANCE OF ELECTRIC ENERGY FROM NUCLEAR POWER. Angelini, A. M. (ENEL, Rome). Energ. Nucl. (Milan); 22: No. 3, 120-230(Mar 1975). (In Italian).

From 13th nuclear energy conference on nuclear energy in perspective; Milan, Italy (12 Dec 1974).

After a brief survey of the main aspects characterizing today the nuclear source, the orientations and studies of OECD, the Commission of the European Communities, and UNIPEDE are discussed. The forecasts of development of the electric energy demand in the next 10 to 15 years, and the role the nuclear source shall play in the fulfillment of this demand are examined. This examination substantially shows that, whereas the overall energy demand will increase in the period considered with a rate somewhat lower than envisaged before the energy crisis, the demand of electric energy, after a short slackening period, will start to increase again with a rate not lower and maybe higher than in the past, and the most convenient energy source to face nearly all the new requirements of electric energy in industrialized countries — for economic, ecological, currency, safety, supply and availability reasons — is the nuclear one. ENEL's nuclear power programs are also specified and the financial and site availability problems are underlined. (auth)

28838 $15 BILLION EXPANSION DOUBLES CAPACITY. Mod. Power Eng.; 68: No. 12, 46-47(Dec 1974).

It is estimated that an expansion of Ontario's power system by 92% is needed to meet increasing energy demands over the next eight years. About $15 billion will be spent on this expansion. A large part of it will go toward nuclear development, which is expected to quadruple from 2.3 million kW to 8.8 million kW. (CA)

28839 POWER PREVIEW AND FORECAST: 1974–1978. Mod. Power Eng.; 68: No. 12, 41-43(Dec 1974).

Total electrical generating capability in Canada is expected to reach 72.5 million kW by 1978. Of this, 6.51% will be generated by nuclear power plants. Nuclear capacity is expected to double, thermal plant capacity to increase by 53%, gas turbine capacity to increase by 72%, and hydro projects are only expected to grow by 20%. Ontario will lead in generating capacity growth. Details are given for individual provinces. (CA)

28840 ECONOMIC EVALUATIONS OF NUCLEAR POWER PLANTS USING MONTE CARLO SIMULATION. Hoge, J. B. Power Eng.; 78: No. 12, 36-38(Dec 1974).

The EVANC (Evaluation of Nuclear Costs) computer code, which can perform comprehensive and rapid economic comparisons of up to 25 nuclear power plants, is discussed. The results of a sample calculation are presented for a hypothetical 1200-MW(e) unit. (DG

Reactor Fuel Cycle Economics

Refer also to abstract 25356.

28841 (CNEA–375) URANIUM REQUIREMENTS FOR DIFFERENT LONG-TERM REACTOR STRATEGIES. Solanilla, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 30p. (In Spanish). Dep. NTIS (US Sales Only) $4.50.

The influence on nuclear fuel consumption due to different long term power reactor strategies that may be applied in Argentina is evaluated for the coming 30 years. 11 references. (auth)

28842 (CNEA-EN-40/128) PRODUCTION OF NEPTUNIUM-237 IN ARGENTINA REACTORS. Maroto, A. J. G.; Kaufmann, F.; Flegenheimer, J. G. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Mar 1974. 15p. (In Spanish). INIS.

The production of neptunium-237 in Argentine reactors is described as a function of the installation of reactors in the country. The possible influence of its separation on the economy of plutonium production is discussed. (auth)

28843 (EUR-4625) CONTRIBUTION OF THE THORIUM CYCLE TO AN OPTIMUM UTILIZATION OF NUCLEAR FUEL IN POWER REACTORS. Lavrencic, D.; Valant, P. (Commission of the European Communities, Brussels (Belgium); Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1971. 234p. (In Italian). INIS.

The importance of the role thorium could play in the long-term development of nuclear energy has been examined. This included: the compilation of an inventory of presently known thorium resources; an analysis of the economic advantage of the thorium cycle; an examination of the problems of the conversion rate (breeding or near-breeding); and an attempt to determine the proportion of thorium reactors in various strategies: a) from the point of view of total energy production; b) from the point of view of supplies. (INIS)

28844 COMPUTER CODE FOR REFUELING AND ENERGY SCHEDULING CONTAINING AN EVALUATOR OF NUCLEAR DECISIONS FOR OPERATION. Kazemersky, P. M. Columbus, OH; Ohio State Univ. (1974). 223p. University Microfilms Order No. 75-3110.

Thesis (Ph. D.).

A model is presented which can be used to determine an optimal multi-year system operating schedule by simultaneously scheduling energy production and refueling dates to nuclear units and energy production to non-nuclear units which comprise the utility system. The application of the model to a hypothetical utility system illustrates its capacity to seek an optimal system operating schedule which provides significant economic benefits. From the cases analyzed, it was found that: the nuclear units operated with cycle lengths varying from 12 to 18 months and not equilibrium cycles; the system must be optimized in its entirety; significant cost benefits can be achieved by optimization of the utility system; variable refueling dates increase the complexities of the scheduling problem; and the model is flexible and can readily address a wide variety of system configurations and perturbations. (Diss. Abstr. Int., B)

Reactor Licensing and Regulation

28845 (AED-CONF-73-670-001) DIFFERENCES IN THE VARIOUS NATIONAL ATOMIC AND POLLUTION ABATEMENT

LEGISLATIONS AND THEIR EFFECTS UPON INTERNATIONAL COMPETITION IN THE NUCLEAR INDUSTRY. Schirnack, W. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). 1973. 12p. (In German). INIS.

From working meeting on international and European law; Goettingen, F. R. Germany (22 Nov 1973).

The basic features of this controversial problem, "different national pollution abatement laws-competitive distortions" are outlined, the financial reasons for this situation and possible means of curbing such competitive distortions (of particular importance to German manufacturers in the nuclear industry) are discussed. (GE)

28846 (DOCKET-50029-408) YANKEE NUCLEAR POWER STATION. Semiannual Operating Report, July–December 1974. (Yankee Atomic Electric Co., Westboro, Mass. (USA)). 27 Feb 1975. 60p. Dep. NTIS $6.00.

After refueling operations were completed on August 25th, the plant operated at power most of the balance of the time with brief shutdowns and load reductions. Net electrical power generated was 518,620.243 MWH. Information is presented concerning operation, power generation, shutdowns, maintenance, chemistry and radiochemistry, occupational personnel radiation exposure, release of radioactive materials, and abnormal occurrences. (FS)

28847 (DOCKET-50133-235) HUMBOLDT BAY POWER PLANT, UNIT 3. Semiannual Report, July–December 1974. (Pacific Gas and Electric Co., San Francisco, Calif. (USA)). 28 Feb 1975. 87p. Dep. NTIS $7.50.

Operating Cycle 9 was in progress at the beginning of the report period with the Unit operable at a rated load of 215 MW(t), 65 MW(e). The end-of-cycle coast down began on August 1, with two central control rods partially inserted into the core due to fuel defects. By the end of Cycle 9 the Unit's capacity had been reduced to 47 MW(e) due to fuel depletion. The off-gas release rate prior to shutdown was approximately 28,000 μCi/sec and the primary system leakrate was less than 0.1 gph. On October 30, the Unit was shutdown for the annual refueling and maintenance outage. The outage work consisted primarily of fuel sipping to identify failed fuel assemblies, reconstitution of the reactor core, fuel (Exxon) and material surveillance inspection, replacement of a control rod drive, and repairs to the reactor feedwater sparger. Nondestructive and visual inspections were conducted on portions of the primary and containment systems. Several modifications to plant systems were made to increase the protection provided against high energy line breaks. The turbine work consisted of repairs to the steam crossover piping and inspection and/or repair of the steam seal regulator, governor system, control valves, high pressure seals and turbine shaft bearings 1 and 2. The Unit was returned to service on December 27 to begin Operating Cycle 10. Net power generated was 146,331 MW(e) hours. Information is presented on design changes, performance characteristics, shutdowns, changes, tests, experiments, radioactive effluent releases, and occupational personnel radiation exposures. (FS)

28848 (DOCKET-50206–354) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Semiannual Operating Report No. 15, July 1, 1974–December 31, 1974. (Southern California Edison Co., Rosemead (USA)). 12 Feb 1975. 32p. $4.75 NTIS

The facility operated at full power (450 MW(e)) from the start of the period until July 7, when it tripped from an over-power condition caused by water intrusion in two power range channels. The unit returned to service on July 9 and operated until August 20 when it tripped on pressurizer high level, and was returned to service the same day. On September 4, it was removed from service to replace a power range detector package and install axial offset detectors. The unit returned to service September 5th and operated to October 18 when it was removed from service for reheater maintenance and operator examinations. The unit returned to service on October 21 when it was manually tripped because of dropped rods and returned to service the same day and operated at full load for the rest of the period. Net electrical power generation for this reporting period was 1,782,407 MWH(e). Information is presented concerning operation, power data, shutdowns, corrective maintenance, changes in facility design, radioactive effluent releases, environmental monitoring, and operational personnel radiation exposure. (FS)

28849 (DOCKET-50219-647) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Semiannual Operating Report, July–December 1974. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 28 Feb 1975. 77p. Dep. NTIS $7.00.

Operating statistics are presented describing reactor and generator operations. The plant operated with an availability factor of 70.36% and a capability factor of 67.64%. During the reporting period there were three orderly plant shutdowns and one automatic reactor scram. The shutdown on July 13th through July 15th was due to an inability to maintain drywell N_2 content. The shutdowns on October 8th through October 15th and November 11th through November 15th were due to high unidentified drywell leakage. The reactor scram on September 25th was initiated by the turbine acceleration relay when the generator reacted to a system disturbance. There were in addition, twenty-one load reductions. Eleven of the load reductions were made for repairs on leaking main condenser tubes, seven of the load reductions were made to accommodate core neutron flux shaping, one was to perform the main steam isolation valve full closure test, one was to isolate "C" feedwater string for maintenance and one was to perform a control rod sequence interchange. Cycle IV operations commenced on July 1, 1974 with a core composed of 184 Type I and 152 Type II fuel assemblies manufactured by plus 4 Type III-A, 148 Type III-E, and 72 Type III-F fuel assemblies manufactured by Exxon. At the beginning of this fuel cycle operating recommendations for power level changes to minimize fuel failures were followed, but, on September 26, 1974 operating recommendations submitted by Exxon were received, reviewed and followed thereafter. The effects of the adoption of the Exxon recommendations were: achieving full power rod patterns more quickly due to a 2KW/ft increase in the control rod movement cutoff local linear heat generation rate, and a more rapid rate of power increase during fuel preconditioning operations. Radwaste, environmental, chemistry, facility changes, tests, experiments, and personnel radiation exposures are summarized. (FS)

28850 (DOCKET-50250-347) TURKEY POINT PLANT, UNITS 3 AND 4. Semiannual Operating Report No. 5, June–December 1974. (Florida Power and Light Co. (USA)). 20 Feb 1975. 134p. (DOCKET-50251-330). Dep. NTIS $9.75.

Both units were essentially base loaded at rated power. Unit 3 generated 1,401,912 MWH(e) and Unit 4 generated 2,301,652 MWH(e) net electrical power. The first refueling for Unit 3 was accomplished between October 6 and December 15. Information is presented on operations, power generation, shutdowns, maintenance, changes, tests, experiments, radioactive effluent releases, radiological monitoring, and occupational personnel radiation monitoring. (FS)

28851 (DOCKET-50261-479) H. B. ROBINSON PLANT, UNIT 2. Semiannual Operating Report No. 9, July–December 1974. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 25 Feb 1975. 153p. Dep. NTIS $10.75.

Operations for the past six months were routine with two weekend maintenance outages occurring. The reserve shutdown hours for this period were zero and the maximum dependable capacity was 665 MW(e) (net). Monthly summaries are presented concerning operations, abnormal occurrences, power generation, outages and maintenance. Surveillance tests and inspections, modifications to the facility, changes in operating procedures, performance characteristics, effluent accountability, waste management, dosimetry, chemistry, and the environmental programs are discussed. (FS)

28852 (DOCKET-50271-474) VERMONT YANKEE NUCLEAR POWER STATION. Semiannual Operating Report, July–December 1974. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 5 Mar 1974. 69p. Dep. NTIS $6.50.

Information is summarized concerning operations; including facility design changes, performance characteristics, operating procedure changes, surveillance, containment leak testing, tests, and staff changes; power generation; shutdowns; maintenance; primary coolant chemistry; occupational personnel radiation exposures; radioactive materials release; abnormal occurrences; and special topics. Special topics include inspection of hydraulic shock suppressors, and suppression chambers, removal of suppression chamber baffles, open cycle tests and non-radiological reportable data. Net electrical power generated was 2,482,564 (MWh) with a net efficiency of 30.3% and reactor availability of 74.1%. (FS)

28853 (DOCKET-50285-295) FORT CALHOUN STATION, UNIT 1. Semiannual Operating Report, July–December 1974. (Omaha Public Power District, Nebr. (USA)). 26 Feb 1975. 180p. Dep. NTIS $12.00.

The facility generated 1,421,360.4 MWH(e) with the generator on line 4,106.5 hrs. The plant was administratively limited in power pending modification of main steam line isolation valves. Summaries concerning operations, power generation, shutdowns, maintenance, changes, tests, experiments, radioactive effluent releases, solid radioactive waste, environmental monitoring, occupational personnel radiation exposure, and primary coolant chemistry are presented. (FS)

28854 (DOCKET-50312-173) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Annual Report, 1974. (Sacra-

mento Municipal Utility District, Calif. (USA)). 1 Mar 1975. 95p. Dep. NTIS $7.75.

Major plant activities involved completion of preoperation testing, fuel loading completed on August 23rd, start-up testing, and completion of the 40% operation test. The operating license was issued August 16 and initial criticality was achieved September 16th. Zero power physics tests were completed on October 3rd with initial turbine roll on October 11th and grid synchronizing on October 13th. Summaries, by month, are presented for design changes, performance characteristics, changes in operating methods, surveillance testing, containment leak rate tests, and reactor shutdowns. Effects of the plant on the environment were minimal, but higher than desirable chlorine levels were experienced in the plant effluent. Minor amounts of plant radioactivity were released. Measurements of radioactivity in the air, water, soil, vegetation and animal life indicated there were no significant contributions from reactor operation. (FS)

28855 (FIND-50460) FIND: WPPSS NUCLEAR PROJECT NO. 1 AND NO. 4. Washington Public Power Supply System. Items 1–46. Horn, F. H. (ed.). (USERDA Technical Information Center, Oak Ridge, Tenn.). Feb 1975. 27p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

28856 (FIND-STN-50470) FIND: STANDARD SAFETY ANALYSIS REPORT (CESSAR). Hendricks, P. L. (ed.). (USERDA Technical Information Center, Oak Ridge, Tenn.). Feb 1975. 55p. Dep. NTIS $5.45.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

28857 (FIND-STN-50480) FIND: WESTINGHOUSE NUCLEAR ENERGY SYSTEMS REFERENCE SAFETY ANALYSIS REPORT (RESAR-41). Horn, F. H. (ed.). (USERDA Technical Information Center, Oak Ridge, Tenn.). Mar 1975. 42p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

28858 (NEDO-20340-1) PROCESS COMPUTER PERFORMANCE EVALUATION ACCURACY. Amendment 1. Carew, J. F. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Dec 1974. 37p.

28859 (NP–20321) TOPICAL REPORT UEC-TR–001-0: QUALITY ASSURANCE PROGRAM. (United Engineers and Constructors, Inc., Philadelphia, Pa. (USA)). 12 Nov 1974. 61p. United Engineers and Construction Inc., Philadelphia, PA.

United Engineers & Constructors Inc. (UE&C) have established and implemented a Quality Assurance Program to provide assurance that the design and construction of nuclear power plants, performed by UE&C, are in conformance with applicable regulatory requirements and with the design bases specified in the license application. The Quality Assurance Program described is in compliance with the requirements of Appendix B to 10CFR Part 50. This report addresses and is responsive to the United States Atomic Energy Commission Regulatory Guide 1.70.6, dated July 1974, which describes additional information required in the Quality Assurance Section of the Preliminary Safety Analysis Report for Nuclear Power Plants. (auth)

28860 (NRCI-75/1) NUCLEAR REGULATORY COMMISSION ISSUANCES, JANUARY 19-31, 1975. (USERDA Technical Information Center, Oak Ridge, Tenn.). Jan 1975. 46p. TIC $4.00.

Issuances received from the U. S. Nuclear Regulatory Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (DG)

28861 (NUREG/PRDI-75-3) POWER REACTOR DOCKET INFORMATION. (USERDA Technical Information Center, Oak Ridge, Tenn.). Mar 1975. 89p. TIC $1.85.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the U.S. Nuclear Regulatory Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (DCC)

28862 (REG/G-1.64(Rev.1)(2-75)) QUALITY ASSURANCE REQUIREMENTS FOR THE DESIGN OF NUCLEAR POWER PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 2p. NCR.

Interpretations and explanations of specific sections of standards and regulations governing quality assurance are provided. (DG)

28863 (REG/G-1.70.22(2-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS. Instrumentation and Controls. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 4p. NCR.

Requirements for identification of safety-related systems and identification of safety criteria discussed. Pertinent Regulatory Guides and National Standards are listed. (DG)

28864 (REG/G-1.70.23(2-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS. Seismic Qualification of Instrumentation and Electrical Equipment. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 3p. NCR.

Requirements are listed for information on seismic qualification of Seismic Category I instrumentation and electrical equipment. Seismic qualification criteria, methods and procedures for qualifying electrical equipment and instrumentation, methods and procedures of analysis or testing of supports of electrical equipment and instrumentation, and operating license review are included. (DG)

28865 (REG/G-1.70.24(2-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS. Environmental Design of Mechanical and Electrical Equipment. Qualification Tests and Analyses. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 3p. NCR.

The values of temperature, pressure, humidity, chemicals, and radiation are to be specified both for the operating environment of the equipment and for the conditions of the tests and analyses to assure performance of the equipment under actual operating conditions. (DG)

28866 (REG/G–1.70.25(2-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS. Inservice Inspection of ASME Code Class 2 and 3 Components. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 4p. NCR.

Specifications are given for information concerning the following: (1) identification of components subject to examination, (2) accessibility, (3) examination techniques and procedures, (4) inspection intervals, (5) examination categories and requirements, (6) evaluation of examination results, (7) system pressure tests, and (8) augmented inservice inspection to protect against postulated piping failures. (auth)

28867 (REG/G–1.70.26(2-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: METALLIC MATERIALS FOR ENGINEERED SAFETY FEATURES. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 4p. NRC.

Required information concerning materials selection and fabrication and composition, compatibility, and stability of containment and core spray coolants is specified. (DG)

28868 (REG/G-1.95(2-75)) PROTECTION OF NUCLEAR POWER PLANT CONTROL ROOM OPERATORS AGAINST AN ACCIDENTAL CHLORINE RELEASE. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 5p. NCR.

Specifications are given for chlorine storage and detection, area isolation and ventilation, and protective clothing and emergency breathing equipment. Criteria for emergency procedures are discussed. (DG)

28869 (REG/G-4.2(Rev.1)(1-75)) PREPARATION OF ENVIRONMENTAL REPORTS FOR NUCLEAR POWER STATIONS. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Jan 1975. 77p. NRC Free.

General requirements for the preparation of environmental reports for nuclear power plants are presented. (JWR)

28870 (WASH-1355) NUCLEAR POWER FACILITY PERFORMANCE CHARACTERISTICS FOR MAKING ENVIRONMENTAL IMPACT ASSESSMENTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1974. 240p. Dep. NTIS $7.60. GPO $3.35.

Design performance characteristics of LWR power plants which significantly affect the environment are identified and quantified. Several models used to assess environmental impacts are presented or referenced. A set of design performance characteristics for a hypothetical nuclear power plant is derived for a composite of design data and expressed numerically as envelopes whose

bounds describe existing technology for custom-designed LWR plants. (auth)

28871 THE EVOLUTION OF PRESENT-DAY USAEC SEISMIC AND GEOLOGIC CRITERIA. Fischer, J. A.; Singh, H. (Dames and Moore, Cranford, N. J. (USA)). Nucl. Eng. Des.; 29: No. 2, 196-201(Dec 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Some general insight into the evolution of present-day USAEC seismic and geologic criteria for nuclear power plant design is presented. The types of investigations which are necessary to meet the present criteria in the selection of seismic design parameters are discussed. (auth)

28872 ORDER OF THE COURT AGAINST NUCLEAR POWER PLANT GRAFENRHEINFELD. Energiewirt. Tagesfragen; 24: No. 11, 587-590(Nov 1974). (In German).

The action for annulment of the licensing of construction of Grafenrheinfeld nuclear power plant, which has been initiated by the city of Schweinfurt, has been confirmed by order of the administrative court of Wuerzburg on August 26, 1974. (GE)

28873 THIRD GERMAN ATOMIC ENERGY LAW SYMPOSIUM. Energiewirt. Tagesfragen; 24: No. 11, 573-576(Nov 1974). (In German).

From 3rd German symposium on atomic energy law; Goettingen, F. R. Germany (22 Oct 1974).

A brief review of the papers held at the 3rd German Symposium on Atomic Energy Law is presented. (GE)

28874 AEC WORKING PAPER ON POPULATION DENSITY AROUND NUCLEAR POWER-PLANT SITES. Buchanan, J. R. Nucl. Safety; 16: No. 1, 1-8(1975).

A proposed regulatory guide, "Population Distribution Around Nuclear Power Plants," which the AEC considered issuing to provide guidance on acceptable population characteristics for a nuclear reactor site is reviewed. The proposed AEC guide involved cumulative population projections within 5, 20, and 40 miles of the site. Two techniques for evaluating population distributions around sites are also discussed. The first technique is the use of an unweighted cumulative population vs. distance. The second technique is called a site population factor for the purpose of comparing sites, and this technique weights population at longer distances less than the population adjacent to a site. The AEC is continuing work on these potential tools. All presently approved sites have been found to be acceptable in terms of population density as well as by other considerations. (auth)

28875 DEMANDS FOR DECOMMISSIONING OF STADE NUCLEAR POWER PLANT REJECTED. Energiewirt. Tagesfragen; 24: No. 10, 516-524(Oct 1974). (In German).

Statements made during legal proceedings referring to technical and biological-physical problems involved with operation of the Stade reactor have met with some concern on the part of experts. Some of the reasons are discussed. (GE)

GENERAL AND MISCELLANEOUS

Civilian Defense

28876 (AD-778674) GRADED SET OF SUMMARY SCENARIOS FOR NUCLEAR ATTACK. Final Report. Laurino, R. K.; Bjorklund, P. B.; Miller, C. F. (System Sciences, Inc., Palo Alto, Calif. (USA)). 31 May 1973. Contract DAHC20-72-C-0309. 46p. NTIS $5.50.

The study developed a wide range of nuclear scenarios for use in DCPA training exercises. The report describes the scenario design consideration, including the relationships of scenario design to training objectives. Using the design principles, a simple computer program was developed that permits automatic generation of scenarios using a remote terminal device. (auth)

28877 (AD-785916) NATURAL THERMAL VENTILATION EXPERIMENTAL STUDIES. Final Report, March 1973–August 1974. Wright, M. D.; Botkin, G. M.; Hill, E. L. (Research Triangle Inst., Durham, N. C. (USA)). Aug 1974. Contract DAHC20-71-C-0275. 112p. (RTI-FR-43U-629-3). NTIS $5.25.

This report describes an experimental program to determine the relationship between volume air flow and temperature differential in a simulated fallout shelter with various aperture configurations as a result of the thermal buoyancy effect created by the heat given off by shelter occupants. (auth)

28878 (AD-787042) CONSTRAINTS ON CIVIL DEFENSE OPERATIONS IN PHYSICALLY DAMAGED AREAS. Final Report. Miller, C. F. (Dikewood Corp., Albuquerque, N. Mex. (USA)). Sep 1974. 78p. NTIS $4.75.

Constraints on civil defense operations in urban areas that are exposed to blast and thermal effects of nuclear explosions have been analyzed, discussed, and summarized. The peripheral constraint in both the emergency period and the post-attack period on the conduct of operations appears to be debris in the street. Thus, debris removal would be one of the most important initial countermeasures for damaged urban areas. The results of an empirically-based debris production model have been summarized and extended. The analysis indicated that, for nuclear explosion effects on a warned population in modern urban areas, the blast effect will be more casualty-producing than the thermal effect. (GRA)

28879 (UCRL-51734) NEW QUESTIONS IN STRATEGIC THEORY. Gustavson, M. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Feb 1975. Contract W-7405-Eng-48. 10p. Dep. NTIS $4.00.

The strategic nuclear posture of the United States is based on theoretical constructs formulated early in the nuclear era. Foreseeable changes, both political and technological, raise questions that lie outside this theoretical framework. Several of these developments are pointed out, and the inadequacies of existing theory are illustrated. The extensions to present theory required to encompass the impending decisions or new questions in strategic theory are outlined. (auth)

Energy Utilization and Economics

28880 OIL SHALE COUNTRY FACT BOOK: GARFIELD, MESA, MOFFAT, AND RIO BLANCO COUNTIES, COLORADO. Wengert, N. (comp.). Denver; Colony Development Operation ([nd]). 641p. $10.00.

A compilation of data on the four counties is presented; emphasis is placed on Garfield County. The following subjects are included: introduction and general description; population; government structure; government finances; government taxes; education; health, welfare, and recreation; housing; transportation; municipal services; business; community organizations; climate; and agriculture. (JGB)

Law

Refer also to abstract 28873.

Management

28881 (TID/SNA-197) MANAGEMENT, OPERATION, AND MAINTENANCE OF THE HANFORD WORKS CHEMICAL SEPARATIONS FACILITIES. (Aerojet-General Corp., El Monte, Calif. (USA)). May 1967. 191p. Dep. NTIS $12.75.

A proposal for the management, operation, and maintenance of the AEC's Hanford chemical separations facilities by the Aerojet-General Corp. is presented in the following sections: prerequisites to selection; operation of the Hanford plant, including personnel and organization, takeover plan, and related considerations; industrial diversification; and personnel. (JGB)

28882 McMASTER UNIVERSITY NUCLEAR SCIENCE RESEARCH REPORT. Hamilton; McMaster University (1975). 190p.

The report summarizes the research carried out during 1974. The introductory chapter briefly outlines the history of nuclear science at the University and describes the nuclear reactor and the Tandem Van de Graaff Accelerator around which the program has developed. Progress reports from the research groups using these facilities are presented in Chapter 2 and Chapter 3 under the headings of Nuclear Structure Research and Applications of Nuclear Techniques to Research in Other Fields (i.e. Solid State and Materials Research, Science and Engineering Research, Biological and Medical Research). These progress reports are followed in Chapter 4 by reports from the Superintendent of Reactor Operations and the Director of Accelerator Operations. (auth)

Mathematics and Computers

28883 (AERE-R-7824) MODEL FOR STUDYING HIGH LEVEL PROTOCOLS IN DISTRIBUTED COMPUTER NETWORKS. Howard, V. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Dec 1974. 42p. Dep. NTIS (US Sales Only) $5.25.

A model is described of a distributed computer network implemented as part of a research program on the development and use of computer networks. The model forms a research tool suitable for wide ranging experiments on high level protocols by providing a network on which such protocols can be readily implemented. The report identifies the major components and boundaries of the model and describes one particular use of the model, an implementation of a Host-Host protocol developed from that of the well-established ARPA network. (auth)

28884 (IS-3497) ELEMENTARY CHARACTERIZATION OF SOLUTIONS OF FREDHOLM EQUATIONS OF THE FIRST KIND. Peterson, W. C. (Ames Lab., Iowa (USA)). Nov 1974. Contract W-7405-eng-82. 12p. Dep. NTIS $4.00.

Solutions of Fredholm equations of the first kind are characterized in terms of a known solution and the null space. Several examples are given illustrating the relationship. (auth)

28885 (JINR-10-7194) PROGRAMS FOR THE IPN AND THE BSEM-6 CONNECTION. Subroutine for Operation with the GDS-608 Tape Recorder. Galaktionov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 21p. (In Russian). INIS.

The study describes the program software for Fortran stations receiving and accepting information from a BESM-6 computer, and a subprogram for operating on a TRA computer equipped with a SDS-608 tape recorder. (tr-SJR)

28886 (JINR-10-7195) AUTOCODE STANG 3 FOR COMPUTER TRA (SUPPLEMENTS). Galaktionov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 9p. (In Russian). INIS.

The study describes additions to the autocode STANG 3 for a small TRA computer, from which the translator operates on a BESM-6 computer. The additions deal with expanding the structure of the full addresses of the commands, and expanding the alphabet of the language and list of mnemonic commands. In a new variant of the translator, allowance is made for handling a packet, consisting of a number of independent programs, with establishment or redetermination of the translation solution for each program. (tr-SJR).

28887 (JINR-10-7196) MONITORING SYSTEMS OF A FORTRAN STATION. Galaktionov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 18p. (In Russian). INIS.

A monitoring system of a Fortran station through a system of commands set up on the teletape of small TRA computer organizes the introduction, editing, and transmission of user's problems to a BESM-6 computer. The results of calculating these problems on the BESM-6 computer are returned to the Fortran station, and are distributed to external units in accordance with the commands of the BESM-6 computer. (tr-SJR)

28888 (JINR-10-7692) DIGITAL-TO-TIME CONVERTER TVP-351 DESIGNED IN THE CAMAC STANDARD. Kryachko, A. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of

High Energy). 1974. 10p. (In Russian). INIS.

The study describes a digital-time converter that is used as a stable generator of timed pulses with a programmed frequency, of programmed timed intervals, and as a recorder with a programmed scaling coefficient. The circuit meets the CAMAC standard. (tr-SJR)

28889 (JINR-10-7847) PROGRAMS FOR STATISTICAL DATA STORAGE AND FORMATION ON TRA-1001-TYPE COMPUTER. Khaupt, Kh.; Khoshenko, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 10p. (In Russian). INIS.

A description is given of a program intended for the accumulation of statistical data and forming the data for subsequent output or accumulation in the form of histograms. Floating arithmetic programs are not used. (tr-SJR)

28890 (JINR-11-7828) COMMAND LANGUAGE FOR A SMALL COMPUTER EMULATION. Kavchenko, A. V.; Karlov, A. A.; Polyntsev, A. D.; Smolyakova, T. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 15p. (In Russian). INIS.

A description is given of a command language (a system of control cards) that comprises the software on large computers BESM-6 and C-1604A for a small M-6000 computer that translates programs from autocode and Fortran language, incorporates programs from one carrier into another, and obtains translated programs of a given carrier and executes them in a mode of simulation. (tr-SJR)

28891 (JINR-P11-8510) MICROPROCESSOR COMPUTING POWER. Zamori, Z.; Ososkov, G.; Khorvat, A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 22p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

In the middle of 1974, the first powerful and flexible microprocessor on a chip-INTEL 8080 appeared on the market. Its computing power is analyzed on the ground of the GIBSON-III instruction mixture. It is found that its GIBSON index is only 4 to five times less than those of the well known medium computers EC-1020 or IBM 360/30. Some hints are made on the foreseeable prompt and drastic changes of all conceivable computing activities. (tr-auth)

28892 (LA-5879-MS) MONTE CARLO METHOD FOR PROBLEMS OF HIERARCHICAL INFERENCE. Everett, C. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1975. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

A simple Monte Carlo method is presented for estimating the probability $p(S_1,\ldots,S_K|h)$ of the state vector $(S_1,\ldots,S_K)$ of the K terminal (data) nodes in a general inference tree (with an arbitrary number of nodes, each having a prescribed number of possible states) assuming the "hypothesis" node to be in state h. From this information, the probability $p(h|S_1,\ldots,S_K)$ of hypothesis h, assuming an observed state vector $(S_1,\ldots,S_K)$ at the terminal nodes, is then computed from Bayes' formula. The whole routine is easily coded, and a flow chart is included. (auth)

28893 (LA-UR-75-27) COMPUTING FACILITIES AT LOS ALAMOS SCIENTIFIC LABORATORY. Worlton, J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1 Jan 1975. Contract W-7405-eng-36. 4p. (CONF-740689-1). Dep. NTIS $4.00.

From ANL-AUA workshop on planning for a national center for computational chemistry; Argonne, Illinois, USA (7 Jun 1974).

The Central Computing Facility (CCF) of LASL contains eight major computers. Assuming that each computer provides about 500 hours per month of operational use time, and that the computational capacities are as stated, the CCF offers the equivalent of about 28,500 hours of 7600 time per year. Four operating systems are maintained for use with the CCF computers: the KRONOS time-sharing system for the CDC-6600s and the CDC-Cyber-73s; the LTSS time-sharing system and the CROS batch system for the CDC-7600s; and the Hydra network control system for control of the mass storage system and for remote job entry. These operating systems offer the LASL users interactive access from Keyboard terminals and remote job entry from computer-based terminals, in addition to the traditional shelf batch capability. (MCW)

28894 (ORO-3443-51) ANGLE CONDITION IN THE FINITE ELEMENT METHOD. Technical Note BN-808. Babuska, I.; Aziz, A. K. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Nov 1974. Contract AT(40-1)-3443. 25p. Dep. NTIS $4.25.

The finite element method consists in seeking an approximate solution in the form of piecewise linear junctions and piecewise quadratics. In two dimensions, one of the most used approaches is to triangulate the domain and find the approximate solution that is linear, quadratic in every triangle. A condition that is considered essential is that the angle of any triangle, independent of its size, should not be small, called the minimum angle condition, and is analogous in higher dimensions. This condition is very restrictive when approximate functions are sought that change more rapidly in one direction than in another direction. It is shown that minimum angle condition is not essential, essential being the fact that no angle is too close to 180°. The maximum angle condition is the proper condition. It is shown that the maximum angle condition is sufficient and may be generalized to the n-dimensional case where the triangles are replaced by simplexes. A special theorem is proved in two dimensions where the underlying basic idea may be clearly presented without being encumbered by too many mathematical techniques. (MCW)

28895 (ORO-3443-52) METHOD OF WEAK ELEMENTS. Technical Note BN-809. Babuska, I. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Dec 1974. Contract AT(40-1)-3443. 68p. Dep. NTIS $6.50.

The finite element method is used for solving partial differential equations of elliptic type. The method consists of finding piecewise polynomial approximations of the desired solution. The method does not take any advantage when a special problem such as the Dirichlet for Laplace equation has to be solved. The exact formulation of the weak element method and a mathematical analysis of a special case first appeared in a paper by M. E. Rose, Weak-element Approximation: An Application to the Scattering of a Plane Wave by a Potential. It is the solution of the named weak element in Rose's paper that is studied. The Dirichlet Problem for Laplace's equation in two dimensions is studied. The strong version and the normal version of the weak element method are formulated. Section 2 presents essential notions that are used. Section 3 is devoted to the formulation and first analysis of both versions of the weak element method. Section 4 contains numerical examples and the rate of convergent is discussed in Section 5. (MCW)

28896 (SAND-74-0364) HIERARCHY NETWORK FOR TEST COMPUTERS. Darsey, D. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. Contract AT(29-1)-789. 8p. Dep. NTIS $4.00.

The development of automated testing facilities, each with its own minicomputer and instruments, has resulted in a demand for large memory storage and quick-look data reduction at the testing site. The report describes the development at Sandia, Albuquerque, of an hierarchical network of minicomputers so one large central computer can provide sufficient memory and peripherals for efficiency in software development, data reduction, and storage, yet keep costs to a minimum. (auth)

28897 (SAND-74-0365) MEASUREMENT SYSTEMS USING PROGRAMMABLE CALCULATORS. Darsey, D. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. Contract AT (29-1)-789. 10p. Dep. NTIS $4.00.

The programmable calculator can often be used as an intelligent controller for measurement and control systems. Use of a calculator rather than a minicomputer can simplify programming and interface hardware to save development and maintenance costs. Advantages, disadvantages, and important trade-offs are considered, with an example application in a static load testing laboratory. Calculator-based systems are best applied only when high speed and large quantities of input/output are not of primary importance, but many scientific laboratories may benefit from their simpler setup and programming. (auth)

28898 (UCID-16697) EXAMPLE OF CODE OPTIMIZATION. Rudy, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1975. Contract W-7405-eng-48. 27p. Dep. NTIS $4.50.

The performance of a fully explicit one-dimensional hydrodynamics program is presented for the various large scale computers at Lawrence Livermore Laboratory. The effect of programming techniques on performance is also examined through five versions of the program. (auth)

28899 (UCID-16711) SUITABILITY OF SOFTWARE PHYSICS AS A CHARGING BASIS FOR THE FLOE SYSTEM. Huskamp, J. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Mar 1975. Contract W-7405-Eng-48. 47p. Dep. NTIS $5.50.

The concept of software physics was investigated as a possible charging basis for the CDC 7600 FLOE operating system. The charging equations for cpu usage and disk usage were shown to be inadequate for expressing program charging as a function of program efficiency. To remedy this, alternate equations were proposed. The charging equations for tape usage, however, were shown to be sufficient. The last section of this paper contrasts the relative efficiencies of the CHAT optimized, the PUTT, and the CHAT unoptimized compilers, which are available on the FLOE system, on a sample of fourteen program kernels. (auth)

Miscellaneous

28900 (COO-3134-8) COMPREHENSIVE STUDY OF THE SEISMOTECTONICS OF THE ALEUTIAN ARC. Annual Progress Report, March 1, 1974–February 28, 1975. Davies, J.; Jacob, K. H.; House, L. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory). 1975. Contract AT(11-1)-3134. 48p. Dep. NTIS $5.50.

Seismological, geodetic and geological data were analyzed to derive a coherent theory for the present tectonic processes, geological structure, and tectonic history of the Alaska-Aleutian island arc in the framework of recent advancements in plate tectonics. The seismic and tsunami risk was evaluated particularly in the eastern Aleutian arc (including the Alaska Peninsula) which forms a major section of the boundary between the converging Pacific and North American plates with earthquakes exceeding magnitude 8. Major progress was achieved in collecting and analyzing the first seismicity data from a modern telemetered seismic station network installed recently in the Shumagin Island region, which is a zone of suspected high risk for a possible major destructive earthquake in the not too distant future. This network recorded on April 6, 1974 some moderately large quakes (and numerous aftershocks) including one with maximum magnitude m = 6.0. From the initial analysis of this data, no premonitory seismic effects were detected as yet. Refined methods are presently applied to further search for possible premonitory changes in the seismic velocity ratio v_p/v_s and in the premonitory seismicity pattern of this shock sequence. (auth)

28901 (COO-3161-30) POTENTIAL ENERGY AND FORCE CONSTANTS OF A POTASSIUM CHLORIDE MOLECULE FOR EXTENDED HUECKEL CALCULATIONS. Hathaway, K. B.; Krumhansl, J. A. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Dec 1974. 16p. Dep. NTIS $4.00.

The potential energy and vibrational force constants of a potassium chloride molecule are calculated by the extended Hückel molecular orbital method using analytic approximations to the Hartree–Fock atomic orbitals in the computation of overlaps. The addition of a simple Coulomb attractive energy to the repulsive extended Hückel energy yields total potential energies in reasonable agreement with the experimental energy curve. (auth)

28902 (CSIRO-Trans-11509) CONTRIBUTION TO THE THEORY OF RADIOACTIVE TRANSFER IN AN INHOMOGENEOUS MAGNETIC FIELD. Rachkovskii, D. N. Translated by G. Losonci from Izv. Krym. Astrofiz. Observ.; 44: 64-69(1972). 6p. Dep. NTIS (US Sales Only) $4.00.

Systems of transfer equations in previous work on anomalous dispersion in the theory of radiative transfer in a magnetic field are discussed. Included are a criticism of the equations obtained, results of numerical integration of the equations obtained, and the case of inhomogeneous magnetic fields. (JFP)

28903 (INT-15/PS) DESCRIPTION OF SYMMETRY OF MAGNETIC STRUCTURES BY REPRESENTATIONS OF SPACE GROUPS. Sikora, W. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). 1974. 104p. Dep. NTIS (US Sales Only) $8.25.

The method of describing the symmetry of magnetic structures by representations of space groups is given. It is applied to the description of the symmetry of compounds which are contained in the "Tables of Magnetic Structures Determined by Neutron Diffraction", and their magnetic elementary cell is crystal cell multiple. The results are compiled. The layout of the table is exactly described. (auth)

28904 (LA-5871-MS) ISOTOPE EFFECTS IN THE SCHUMANN–RUNGE BANDS OF MOLECULAR OXYGEN. Hecht, H. G.; Rabideau, S. W.; Engleman, R. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

The Schumann-Runge bands of O_2 were examined with the use of oxygen samples enriched in ^{17}O and ^{18}O. The ($v' = 5, 6, \ldots 13$; $v'' = 0$) bands for various isotopic combinations were measured and analyzed. (auth)

28905 (NTIS/PS-74/085) MATERIAL SHORTAGES: A BIBLIOGRAPHY WITH ABSTRACTS. Report for 1964–Sep 1974. Smith, M. (National Technical Information Service, Springfield, Va. (USA)). Nov 1974. 112p. NTIS $20.00.

The bibliography contains 96 selected abstracts of research reports retrieved using the NTIS on-line search system — NTISEARCH. These abstracts cover availability of manufactured products and raw materials which have become limited in supply in recent times. Subjects are varied including agricultural products, processed food, metals, construction materials, electronic parts, etc. The effect of manpower supply, pollution controls, economics, and land use on material shortages are covered. The report does not include studies on energy shortages. (GRA)

28906 (ORNL-TM-4602) EXPERIMENTAL ENGINEERING SECTION SEMIANNUAL PROGRESS REPORT (EXCLUDING REACTOR PROGRAMS) SEPTEMBER 1, 1973–FEBRUARY 28, 1974. Scott, C. D.; Burtis, C. A.; Pitt, W. W.; Ryon, A. D.; Watson, C. D. (Comps.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1974. Contract W-7405-eng-26. 359p. Dep. NTIS $21.00.

Separate abstracts were prepared for eight individual sections of the progress report. These cover studies on centrifugal fast analyzers, genetic monitoring, high-resolution analytical systems for wastes and biological materials, bioprocesses, water pollution, tritium processing in CTR systems, shipping of plutonium, and chemical engineering. (SFL)

For abstracts of individual sections see: 25455, 26517, 28913–28915, 28918, 28919, and 28943.

28907 (PRNC-177) HYDROGRAPHIC DATA REPORT: NORTH COAST OF PUERTO RICO, 1973–1974. Kendall, T. R.; Wood, E. D.; Smith, T. (Puerto Rico Nuclear Center, Mayaguez). 1974. Contract AT(40-1)-1833. 185p. Dep. NTIS $12.25.

Hydrographic data are presented that were collected along the north coast of Puerto Rico as part of an intensive study to determine the basic oceanographic characteristics of the region. (CH)

28908 (RLO-2041-119) POSSIBILITY OF COHERENT X-RAY PRODUCTION BY COMBINED X-RAY AND LOW FREQUENCY PHOTON PUMPING. Csonka, P. L. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 1974. 7p. Dep. NTIS $4.00.

Under certain stated conditions, the electron population can be inverted in a variety of targets by a combination of x-ray (e.g., originating in a storage ring) and optical (e.g., from a laser) pumping. Coherent x-rays could then be produced by induced emission. (auth)

28909 (UCRL-51730) PHYSICAL-VULNERABILITY CALCULATIONS FOR NUCLEAR WEAPONS USING DIA GREEN BOOK METHODS. Beckham, W. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Jan 1975. Contract W-7405-Eng-48. 20p. Dep. NTIS $4.00.

The calculation of single-shot kill probability (P_k) is central to the work of nuclear weapons operations analysts. The results may lead to crucial decisions concerning the acquisition and use of a weapons system. A fundamental and widely used document in P_k calculations is the Defense Intelligence Agency's "Physical Vulnerability Handbook–Nuclear," more commonly known as the Green Book. The Green Book provides a wide variety of equations, parameters, and procedures for solving a wide range of problems associated with nuclear weapon vulnerability. It sometimes makes simplifying assumptions and generally furnishes estimates of the magnitude of errors to be expected from using these simplifications and from imprecise knowledge of necessary parameters. The Green Book also supplies alternative descriptions for damage probabilities (damage functions), using either peak overpressure (P) or miss distance (R). These alternative descriptions can be made consistent with otherwise well known relationships between P and R, but only by complicating one or both of these expressions. This report aims at helping Green Book users by providing a discussion of the sometimes widely differing answers that can result from using the alternative descriptions. In this discussion, the alternative calculation techniques are compared to the preferred, pressure-description method. Finally, arguments and examples are given for using the "cookie cutter" damage function in calculating P_k. This method, at least in the large number of sample problems presented, gained much in simplicity, but cost nothing in accuracy. (auth)

28910 TRANSPORT PHENOMENA. Sitges International School of Statistical Mechanics, Barcelona, Spain, June 1974. Kirczenow, G.; Marro, J. (eds.). Lecture Notes in Physics, Volume 31. New York; Springer Verlag New York, Inc. (1974). 531p. (CONF-740692-). $16.00.

The lectures on transport theory cover entropy, dynamics, and scattering theory, response, relaxation, and fluctuation, fluctuating hydrodynamics and renormalization of susceptibilities and transport coefficients, irreversibility of the transport equations ergodic theory and statistical mechanics, correlation functions in Heisenberg magnets, the Enskog hard-sphere kinetic equation and the transport phenomena of dense simple gases, Lorentz models, conductivity in a magnetic field, transport properties in gases in the presence of external fields, and transport properties of dilute gases with internal structure. (JFP)

Chemistry

28911 (GAT-786) REMOVAL AND RECOVERY OF HEXAVALENT CHROMIUM FROM INDUSTRIAL EFFLUENTS: A LITERATURE SURVEY. Holland, M. E. (Goodyear Atomic

Corp., Piketon, Ohio (USA)). 21 Feb 1975. Contract AT(33-2)-1. 18p. Dep. NTIS $4.00.

A survey of current literature pertaining to the removal and destruction, and the recovery and reuse of hexavalent chromium in industrial effluents is presented. The majority of the 121 references cited have been published since 1970. Removal of hexavalent chromium from aqueous solutions, recovery of hexavalent chromium for reuse or sale, and destruction of process sludge are pertinent topics in the publications cited. (auth)

28912 (MHSMP-74-35Z) MINIMAL VOLUME SAMPLE MANIFOLD. Period Covered: July–September 1974. Kumpan, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 8p. Dep. NTIS $4.00.

Reliable quantitative analyses of gas samples using gas chromatography can only be obtained with a very stable instrument, a precise sample injection system and an accurate pressure measuring device. The pressure measuring device is necessary to reduce all instrument sensitivities to some unit of pressure. The quantity of the gaseous sample contained between the sample container and the sample injection system cannot be reclaimed for additional analysis without the utilization of a complex and perhaps expensive reclamation device. The sampling system described herein was devised to reduce sample waste to allow satisfactory analysis of all current gas samples. (auth)

28913 (ORNL-TM-4602, pp 120-178) HIGH-RESOLUTION ANALYTICAL SYSTEMS. Dec 1974.

In experimental engineering section semiannual progress report (excluding reactor programs) September 1, 1973–February 28, 1974.

Efforts to improve detector sensitivity and adapt previously developed high-resolution chromatographic systems to new biochemical analyses are continuing. A parametric study of variables involved in reagent development techniques for chromatographic column eluate detection has resulted in a decrease in distortion and improved sensitivity in the cerium oxidimetric detection (COD) system, and that detector technique was successfully applied to the detection of carbohydrates in physiologic fluids, with improved resolution and a decrease in separation time. An improved UV-Analyzer with a COD detector was used in the comparative analysis of both serum and urine samples for two clinically normal subjects after ingesting acetaminophen. Serum concentrations for the glucuronide of acetaminophen exceed those of the free drug. A new metabolite of the drug, S-(5-acetamido-2-glucuronosidophenyl) cysteine, was identified and monitored. (auth)

28914 (ORNL-TM-4602, pp 225-242) WATER POLLUTION STUDIES. Dec 1974.

In experimental engineering section semiannual progress report (excluding reactor programs) September 1, 1973–February 28, 1974.

Automated, high-resolution liquid chromatographs, which were previously developed for the analysis of the molecular biochemical constituents in human body fluids, have been applied to the analysis of various polluted waters. Samples of polluted natural waters were collected at different sites, concentrated up to 10,000-fold, and chromatographed on a high-pressure anion exchange column. Monitoring of the column eluate for ultraviolet absorbance and cerate oxidizability revealed the presence of numerous organic contaminants at concentrations less than 1 μg/liter. Separate fractions of the column eluate were collected and subjected to multiple analyses to identify the individual pollutants. The high-resolution chromatographs are also being used to investigate the effects of using chlorine for disinfection of sewage plant effluents, and as an antifoulant in condenser cooling water. (auth)

28915 (ORNL-TM-4602, pp 263-337) CHEMICAL ENGINEERING RESEARCH. Dec 1974.

In experimental engineering section semiannual progress report (excluding reactor programs) September 1, 1973–February 28, 1974.

The Chemical Engineering Research Program includes a number of fundamental studies that often benefit the mission directed development programs of the Chemical Technology Division. These are separate studies, and attempts are made to keep the investigations fundamental and of broad (general) interest, as well as important. These investigations can be fit into three broad categories: (1) consideration of chemical reaction techniques and systems that may be important to future energy programs; (2) development of advanced separation methods and systems potentially useful in present or anticipated mission oriented efforts; and (3) other fundamental studies, such as advanced methods of data correlation, relevant transport phenomena. Efforts during this report period have included studies of hydrodynamics of packed liquid-liquid columns, mass transfer in open bubble columns and stirred liquid-liquid contactors, tritium recovery from liquid metals by sorption processes, and correlations of liquid CO_2, O_2, CO, and N_2 vapor-liquid equilibria. (auth)

28916 (Y-1968) USE OF A TUNABLE LASER TO INCREASE THE DYNAMIC MEASUREMENT RANGE OF COPPER CONCENTRATION BY ABSORPTION SPECTROSCOPY. Baucum, W. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 24 Mar 1975. Contract W-7405-eng-26. 30p. Dep. NTIS $4.00.

Atomic and molecular absorption spectroscopy is presently limited in measurable concentration range due to, among other things, the inability of instrumentation to provide high-intensity, highly monochromatic incident light for the measurement of high absorbances. A tunable laser can provide such light at the wavelength of maximum sample absorbance and, thus, an experiment was performed to determine the advantages of using a tunable laser as a light source in the absorption colorimetric analysis of copper concentration. The best available tunable laser to be chosen was a pulsed laser, and appropriate detection electronics were designed to quantitatively measure the light intensities. (auth)

Life Sciences

28917 (CONF-741228-1) INHIBITION OF MURINE RNA TUMOR VIRUS EXPRESSION AND TUMORIGENESIS BY POLYADENYLIC ACIDS. Tennant, R. W. (Oak Ridge National Lab., Tenn. (USA)). 1974. 21p. Dep. NTIS $4.25.

From conference on modulation of host immune resistance in the prevention and treatment of induced neoplasias; Bethesda, Maryland, USA (9 Dec 1974).

Combined in vitro, cell culture, and in vivo studies have shown that polyadenylic acids can affect the expression of murine RNA tumor viruses by at least three distinct mechanisms. (CH)

28918 (ORNL-TM-4602, pp 112-119) GENETIC MONITORING. Tiffany, T. O.; Lee, N. E.; Johnson, W. F.; Burtis, C. A. Dec 1974.

In experimental engineering section semiannual progress report (excluding reactor programs) September 1, 1973–February 28, 1974.

The development of automatic instrumentation and procedures useful in genetic screening is continuing. The primary efforts were directed toward a sample preparation system and the development of complementary procedures for detection of mutant proteins. A blood separation system is being developed which will separate plasma from red blood cells, wash the red blood cells (rapidly), remove a portion for storage, and lyse (rupture) the remainder of the cells for preparation of stroma- (debris) free hemolysates. The first prototype of this system was evaluated in the department of human genetics of the University of Michigan. The Centrifugal Fast Analyzer is being used to evaluate the measurement of activity, inhibition, and kinetic parameters of glucose-6-phosphate dehydrogenase with various analogs as a rapid means of detecting G-6PD variants. (auth)

28919 (ORNL-TM-4602, pp 179-224) BIOPROCESS DEVELOPMENT. Egan, B. Z.; Hancher, C. W.; Dinsmore, G. B.; Eubanks, J. P.; Johns, E. R. Dec 1974.

In experimental engineering section semiannual progress report (excluding reactor programs) September 1, 1973–February 28, 1974.

Processes for the preparation of erythropoietin (EPO) from anemic sheep plasma are under development. DEAE-cellulose and carboxymethyl-cellulose column chromatography was used to prepare Step II EPO. A total of 168 sheep yielded 499 liters of plasma, from which 323,000 international units of Step II EPO was obtained. The design and operation of a normobaric hypoxia chamber are described, in which large numbers of mice (up to 250) were made polycythemic for the purpose of assaying EPO. The hypoxic atmosphere was composed of air diluted with nitrogen gas generated from liquid nitrogen. Continuous exposure of mice to 8% oxygen for 11 days resulted in a polycythemia of sufficient magnitude and duration to provide appropriate erythropoietic conditions for testing samples for EPO activity. (auth)

Materials

28920 (COO-1790-7) "IN-SITU" ELECTRON MICROSCOPE INVESTIGATION OF THE NUCLEATION AND GROWTH OF SPUTTERED THIN FILMS. Annual Technical Progress Report VII. Hutchinson, T. E.; Lee, J. I.; Chen, M. M. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). Jan 1975. 35p. Dep. NTIS $4.75.

The study of in situ ion beam sputtering of gold on single crystal silicon substrates shows that substrate/overgrowth interactions greatly influence the growth and structure of the deposits. The data obtained in vacuum of 1×10^{-6} torr showed two major discrepancies with previous results at 10^{-6} torr: (1) At substrate temperatures below 200°C, three dimensional polycrystalline gold islands were

obtained at 10^{-6} torr, while two dimensional polycrystalline gold islands were obtained at 1×10^{-8} torr. (2) Above 200°C, a liquid alloy of gold–silicon was obtained at 10^{-6} torr, but at 10^{-8} torr, the liquid alloy also contained polycrystalline silicon rich regions. Electron beam damage caused a larger number of preferential nucleation sites resulting in island formation early in the growth process. Epitaxial growth and structure of CdS films were reviewed. (PMA)

28921 (COO-3150-29) HELICON WAVES AND ELECTROMAGNETIC GENERATION OF ULTRASOUND IN SIMPLE METALS. Report No. 2277. Chimenti, D. E. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). Aug 1974. Contract AT(11-1)-3150. 123p. Dep. NTIS $9.00.

Thesis.

Results of two related radio-frequency experiments are presented. The magnetic field dependence and magnitude of the high-field Hall coefficient of potassium were determined experimentally by studying the propagation characteristics of high-frequency helicon waves. Between 20 and 100 kG, no significant (±0.5%) field dependence is observed in the Hall coefficient for two different crystalline orientations, while the absolute value is measured to be 4 or 8% larger than the free-electron Hall coefficient, depending upon crystallographic orientation. Geometrical measurements are performed in situ using a direct induction ultrasonic technique. To within 0.05% no change in the Hall coefficient is observed upon reducing the sample temperature from 4.2 to 2.2 K. Recent theories on the magnetoresistance of potassium predict a decreasing Hall coefficient with increasing magnetic field. In the second experiment, the amplitude of electromagnetic generation of ultrasound in monocrystal potassium was measured at 4.2 K as a function of magnetic field from 0 to 15 kG at a frequency of 9 MHz, using inductive means for both generation and detection of the acoustic wave. At zero magnetic field the measured amplitude is several times larger than the free-electron value, and between 0 and 3 kG the experimental curve lies well outside the expected behavior. From 9 to 14 MHz the frequency dependence of the measured amplitude agrees with theory. It is shown that no simple modification of the free-electron calculation can account for the measured enhancement of the zero-field electromagnetic generation amplitude. Measurements of the electromagnetic-to-acoustic generation efficiency were performed on thick aluminum films evaporated onto an insulating substrate. It is found that from 200 to 400 MHz the measured generation efficiency is about five times larger than expected from free-electron theory for bulk metals. It is concluded that the surface scattering mechanism is not important at these frequencies. The acoustic amplitude as a function of magnetic field was also measured. Similar unexplained features that were observed in bulk specimens at lower frequency are present in the current results as well. (auth)

28922 (COO-3151-52) TEMPERATURE DEPENDENCE OF THE F.I.R. ABSORPTION SPECTRUM IN AMORPHOUS DIELECTRICS. Report No. 2374. Mon, K. K.; Sievers, A. J. (Cornell Univ., Ithaca, N. Y. (USA)). Jan 1975. Contract AT(11-1)-3151. 14p. Dep. NTIS $4.00.

The temperature dependence of the absorption coefficient in amorphous dielectrics below 10 cm^{-1} allows for the identity of energy level configurations from population changes at liquid helium temperatures. Over a well defined frequency range a two level mode was identified. (auth)

28923 (LBL-3578) EFFECT OF A POROUS LAYER ON THE KINETICS OF DECOMPOSITION OF CALCITE. Lim, S. C. P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1975. Contract W-7405-eng-48. 23p. Dep. NTIS $4.25.

Thesis.

Weight loss and mass spectrometry measurements have been used to determine the effect of porous alumina barriers on the flux of CO_2 from calcite single crystals and powdered calcite. It is found that the porous alumina barriers reduce the CO_2 flux by less than an order of magnitude, which is in striking contrast to the reduction of a NaCl vapor flux by more than a factor of 100. There are two possible explanations for the high flux of carbon dioxide. One possibility, that the irreversibility of the calcite decomposition is responsible for the high efficiency of transport of CO_2 through porous alumina, was eliminated by means of the calcite powder experiments that provided an equilibrium vapor source. It can then be concluded that the small effect of porous alumina on the CO_2 flux is due to rapid surface diffusion and that this is also the probable mechanism for the efficient CO_2 transport which has been measured through the CaO product layer in calcite decomposition. (auth)

28924 (MHSMP-74-35A) OVERVIEW OF URETHANE SYSTEMS WITHOUT MOCA. Period Covered: July–September. Lichte, H. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. 16p. Dep. NTIS $4.00.

Design and production agencies within the USAEC/ALO complex are developing substitute curing agent systems for MOCA. Most agencies are also substituting other urethane elastomers for Adiprene L-100 and L-167. Engineering data from these agencies are presented. More than forty urethane systems are being evaluated currently, none of which have been designated equal to the L-100/L-167/MOCA series. (auth)

28925 (SAND-74-0334) KINETIC BASIS FOR HYSTERETIC PROCESSES AS EXEMPLIFIED IN FERROELECTRICS. Plumlee, R. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1974. Contract AT(29-1)-789. 78p. Dep. NTIS $7.00.

An asymmetric barrier/well model is presented for analyzing the field-induced polarization reversal in ferroelectrics as a thermally activated rate process. The model yields a simple analytical expression which, with one adjustable parameter, nearly reproduces most ferroelectric polarization/field hysteresis loops. The treatment explicitly derives the "dc" hysteresis loop as an infinitely slow kinetic process. It describes the typical hysteresis half-loop as the product of a Boltzmann exponential distribution factor and a reservoir depletion factor. The saturation polarization density and the coercive field are the measurable material constants in the equation. The adjustable constant is somewhat analogous to the Lorentz local field factor but is postulated to be physically the effective resonance amplification factor (mechanical Q) for vibrational modes excited by passage of phonon packets through the material. The effective frequency factor of the basic kinetic model is viewed as a distribution of individual frequency factors each of which is a function of field, time, resonance mode, mode Q, and phonon frequency and is pertinent to some small polar vibrational element. These elements may range from unit cells to single domains or grains. Accordingly, the frequency factor, like the resonance amplification factor, cannot be derived simply and the model does not yield a useful dynamic switching equation. The analysis, though elementary and lacking in rigor, provides insight into the character of hysteretic processes generally and seems applicable to a variety of phenomena in which the potential barrier that impedes the process is large compared with the field energy that can be applied from an external source. (auth)

28926 (SAND-75-0066) SANDIA LABORATORIES RADIANT HEAT FACILITY. Adams, P. H.; Ault, R. L.; Barber, J. A.; Dillingham, L. A.; Keltner, N. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. Contract AT(29-1)-789. 94p. Dep. NTIS $7.75.

The report: (1) outlines the capabilities and limitations of the Radiant Heat Facility; (2) describes completely the two main types of testing equipment: quartz lamp and graphite resistor heater arrays; (3) outlines the data acquisition capabilities and instrumentation techniques; and (4) gives a short discussion of the theory of radiation heat transfer. (auth)

Physics and Engineering

28927 (BDX-613-1101(Rev.)) AUTOMATIC PHOTOMASK ALIGNMENT AND EXPOSURE ON 3.75 BY 4.50 INCH SUBSTRATES. Schantz, L. E.; Pusch, J. H. (Bendix Corp., Kansas City, Mo. (USA)). Feb 1975. Contract AT(29-1)-613. 81p. Dep. NTIS $5.45.

Automatic alignment and exposure of 3.75 in. × 4.50 in. substrates is discussed as an integral part of a cost effective hybrid microcircuit photolithographic procedure. Exposure light characteristics and automatic mask-to-substrate alignment process technology investigations are described in terms of the physical parameters required to produce hybrid microcircuits. The relation of alignment and exposure to other photolithography operations is discussed. System operational descriptions, set-up procedures, and system deviations from the purchase specification are also presented. (auth)

28928 (BDX-613-1181(Rev.)) EFFECTS OF COATING AND CLEANING ON CORONA AND HIGH-VOLTAGE BREAKDOWN IN ELECTRONIC ASSEMBLIES. Brown, E. R. (Bendix Corp., Kansas City, Mo. (USA)). Feb 1975. Contract AT(29-1)-613. Dep. NTIS $4.00.

A study was made of the effects of coating and cleaning procedures on corona and high-voltage breakdown in electronic assemblies, and preventive techniques to optimize assembly conditions were investigated. Three common types of coating were studied and related to the level of corona start and susceptibility to high potential failure. Surface contamination and entrapped air or gasses were identified as the major causes of degraded corona starting levels and complete dielectric failures in coating systems. (auth)

28929 (BDX-613-1192(Rev.)) FATIGUE FAILURE IN BRAIDED ELECTROMAGNETIC-RADIATION SHIELDING. Ed-

wards, H. J. (Bendix Corp., Kansas City, Mo. (USA)). Feb 1975. Contract AT(29-1)-613. 23p. Dep. NTIS $4.00.

A part of the total endeavor for high-density, braided shields development was devoted to evaluating EMR braided shield solder terminations. Fatigue failures caused by field handling and excessive flexing have come to light recently as a potential source of ineffective EMR shielding. The cable configuration chosen for the testing was the CF1806 pull-out cable. Test cables similar to the CF1806, but with reusable dummy connectors, were designed and fabricated. The normal tin-coated copper shield wire was replaced with insulated magnet wire so that a single wire broken during fatigue testing could be detected. Uninsulated shield wire cross-conducts and precludes detection of single broken wires. The cables were twist-tested horizontally with a 100° (1.75 radian) twist angle at a 45-cycle per minute fatigue rate. Each serialized cable was tested until 15 broken wires were indicated, and the number of fatigue cycles required was recorded. Many cables with the CF1806 termination were tested to establish a basis for evaluating different shield terminations. The base test cables required from 250 to 2000 fatigue cycles while some of the different terminations went as high as 4500 cycles. The need for further testing and development efforts in the area of EMR shield fatigue failures is recognized. (auth)

28930 (BDX-613-1208(Rev.)) LASER STRIPPING FOR WIRE BREAKAGE DIAGNOSIS. Horn, R. T. (Bendix Corp., Kansas City, Mo. (USA)). Feb 1975. Contract AT(29-1)-613. 11p. Dep. NTIS $4.00.

To diagnose breaks in the center conductor of shielded jacket hookup wires, insulation was removed with a carbon dioxide laser. X-ray examination indicated some cracking of the silver-plated copper strands of the center conductor of one wire, and a complete break in a center conductor of the other wire. Mechanical and chemical insulation removal methods could not be used: they either move the wire or use solvents which attack the wire as well as the insulation. Laser scanning was therefore developed to vaporize the outer and inner Teflon insulation in separate passes. The silver-plated copper shielding between the inner and outer insulation was carefully removed strand by strand with sharp tweezers. To minimize movement of the wire, a simple holding fixture was developed. Microscopic examination during and after processing revealed these facts: first, although the laser vaporized the outer insulation, the inner insulation was not affected, implying that the laser might be used to strip the outer insulation to permit examination of stranded shielding; second, microscopic examination of breaks after processing indicated the insulation was removed cleanly without wire damage or movement. (auth)

28931 (BDX-613-1213) APPLICATION OF MOIRE TECHNIQUES TO FIXTURELESS GAGING. Eppes, T. A. (Bendix Corp., Kansas City, Mo. (USA)). Mar 1975. Contract AT(29-1)-613. 51p. Dep. NTIS $5.45.

Moire fringe techniques were studied for use in non-contact gaging for manufactured parts subject to damage or surface deflection from conventional gaging. Contour measurements appear to be feasible for parts which have irregular contours with tolerances over 0.010 in. Major problems which must be solved before contouring can be used as a production inspection tool are: (1) the surface area that can be viewed at one point in time is limited by the size of optics used to generate fringes; (2) part color and surface roughness (texture) limit fringe visibility; and (3) part slopes are limited to ±15° from the perpendicular. (PMA)

28932 (BNL-17960) APPLICATION OF COMPUTER-SCAN METHODS TO PHOTODEFORMATION MEASUREMENTS OF MINE MOVEMENTS. Powell, J. R.; Kopp, J.; Reich, M.; McVey, R.; Lewis, S.; Guidice, E. (Brookhaven National Lab., Upton, N. Y. (USA); Bureau of Mines, Spokane, Wash. (USA). Spokane Mining Research Center). Mar 1973. 79p. Dep. NTIS $7.00.

The computerized scan techniques developed to determine the three-dimensional spatial coordinates of particle tracks in bubble chamber photographs are applied to the measurement of rock surfaces in mines. Such technology could allow rapid, very cheap, and very accurate measurement of movements at many thousands of mine locations. Results are described for a test, carried out jointly by the Spokane Mining Research Center (SMRC) of the U. S. Bureau of Mines and Brookhaven National Laboratory (BNL) at a site selected and prepared by SMRC in the White Pine Copper Mine, White Pine, Michigan. Movements were monitored photographically by BNL and SMRC and checked with a cathetometer by SMRC. After the mechanical roof bolts were relieved at the test site, large cumulative movements, on the order of one-half inch or more, were observed for a number of the markers that were attached to the rock surfaces. Photographs of the markers were taken by BNL at 0.5-hour intervals for two weeks. Marker movements were thus photographically measured every half hour with regard to their initial position. Results are presented and discussed. (WHK)

28933 (BNWL-B-381(DR)) SOURCE BOOK FOR FORTRAN COMPUTER PROGRAMS USED ON THE UNIVAC 1108 IN ENGINEERING CALCULATIONS FOR HEAT TRANSFER, SOLVENT EXTRACTION, ION EXCHANGE, FUEL DISSOLUTION, AND ECONOMIC CALCULATIONS. Jansen, G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1974. Contract AT(45-1)-1830. 379p. Dep. NTIS $7.60.

The programs presented were used for engineering calculations in the fields of heat transfer, induction heating, ion exchange, solvent extraction, fuel dissolution, and economics. Some of these programs were converted to the CYBER, some were converted to conversational BASIC for use on the INFONET system, and all of them were put on magnetic tape for UNIVAC 1108 use at the INFONET center in Los Angeles. Not all of the programs are in good working order, so that sample runs could not be made for some of them, but they are close enough to running so that only minor modifications are needed. Program listings are given and compilations are available on request. (PMA)

28934 (CNEA-379) FAST RESPONSE POTENTIOMETER. Espejo, J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 16p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

The potentiostat is used in corrosion studies of metals by putting some electrodes into electrochemical cells. The potential between the working and reference electrodes and the current in the power electrode indicates the characteristics of the metal. The potentiostat should have a stability of at least 1 mV in five hours and an input impedance of 10^9 minimum. The response speed should be less than 10 us. The stability is very important because any oscillation in the closed loop with the cell can alternate the working electrode and therefore change the results. A potentiostat with the above characteristics is described. It has a unit gain step with high input impedance and a reference power supply with a good stability. (auth)

28935 (EPA-650/4-74-030) DEVELOPMENT OF AIR PARTICULATE MONITORING SYSTEMS. Goulding, F. S.; Jaklevic, J. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1974. 67p. Dep. NTIS $6.50.

Progress is described for the first year of a two year effort to fabricate a high-speed aerosol analysis system. Twelve automated dichotomous sampling stations which collect particles in the 0 to 2 and 2 to 20-μm diameter ranges will be built. An evaluation of a prototype virtual impactor for aerodynamically separating particles into two size ranges is given. Design improvements for minimizing losses are described. Design parameters have been determined for a high-speed energy dispersive X-ray fluorescence spectrometer capable of analysis of elements with atomic numbers above 13. A prototype beta gauge for total mass determination has been tested, and a detection limit of 10 $\mu g/cm^2$ has been measured. For the purpose of sample identification, a system is described by which the X-ray spectrometer and the beta gauge will be able to identify a digital code marked on each filter. (auth)

28936 (JINR-11-7285) PLOTTER WITH STEP MOTORS ON BASE OF THE DRP-3M. Gavrish, P. P.; Gorodnichev, B. D.; Kol'ga, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 15p. (In Russian). INIS.

A description is given of a graph plotter with step motors. A standard table from DRP-3M is used. The process of graph plotting is controlled by a special program from the "NAIRI-2" computer. All logical circuits of the device are made of micromodules. An elementary step is 0.175 mm. The maximum writing rate is 14 cm/sec. The graph can be written in the form of a continuous line or in dotted form. The graph plotter was made in ONU LYaP. (tr-SJR)

28937 (JINR-P11-8494) GRAPHIC DISPLAY USING STORAGE CATHODE-RAY TUBE. Dorukh, Kh.; Levchanovskii, F. V.; Paraskiveski, S.; Prikhod'ko, V. I.; Khoffman, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 18p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A short description of the graphic display using a storage cathode-ray tube is given. The basic modes of operation, the format of graphic commands, and interface between display and mini computer M-6000 are described. (tr-auth)

28938 (JINR-P13-8519) INTERFEROMETER WITH AN AUTOMATIC MEASUREMENT OF THE REFRACTIVE INDEX OF GASES IN A WIDE RANGE OF PRESSURE. Shelkov, G. A.; Shyuler, I. (Joint Inst. for Nuclear Research, Dubna (USSR)).

1975. 14p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A Rayleigh interferometer for the measurement of the refractive index of gases in the range of pressure 0-11 atm is described. A measuring accuracy of the refractive index up to 5×10^{-8} has been obtained. The data from the interferometer are transformed with photodiodes to electrical pulses and transferred to a binary up-down counter. (tr-auth)

28939 (KFKI-75-8) CODE BASED ON THE MIE THEORY FOR CALCULATING CROSS SECTIONS OF PARTICLES IRRADIATED BY LIGHT. Strommer, R. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1973. 19p. Dep. NTIS (US Sales Only) $4.00.

The DSMS code enables the calculation of cross sections of optically homogeneous, spherical, aerosol sized (0.1-5 μm in diameter) particles having real refractive indices, illuminated by a linearly polarized laser beam of arbitrary wavelength. Computation of cross sections for solid angles less than 4π is also possible for comparing results with measurements. (auth)

28940 (MHSMP-74-35V) INVESTIGATION OF THE DEFLECTION AND FLEXIBILITY OF THE IMPACT SURFACE IN THE SKID TEST. Period Covered: July-September 1974. Van Velkinburgh, J. H. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 12p. Dep. NTIS $4.00.

A flexibility factor was defined to characterize skid target deflection, and flexibility factors were measured for a variety of impact surfaces. The magnitude of the apparent flexure of the target was affected by: (1) the nature of the surface (sanded or unsanded); (2) the impact plate thickness; and (3) the method of bonding the impact plates to the concrete test impact target. The range of flexibility factors observed under constant target conditions were due to variations in the explosive billet temperature. (auth)

28941 (NP-20347) DIFFERENTIAL OPERATIONAL AMPLIFIERS UPT-23 AND UPT-24. Andreev, V. I.; Vlasov, K. K.; Gulak, A. A.; Rogov, V. I. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The circuits and parameters of differential operational amplifiers on the base of homemade hybrid integral microcircuits of the type 2HT173 are given. High technical parameters permit to use them in automatic control with an accuracy of ±0.01%. (auth)

28942 (ORNL-4906) COMPUTATIONS, TABLES, AND APPROXIMATIONS FOR GRAIN BOUNDARY DIFFUSION THEORY. Funderlic, R. E.; Young, G. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 69p. Dep. NTIS $5.45.

This report complements the authors' journal article on the grain boundary diffusion theory of Fisher and Whipple. Within the standard assumptions and approximations of this theory, some new tables were computed for the concentration in the grain boundary and for the average concentration in slices cut parallel to the free surface in sectioning experiments. Also tabulated are some related quantities for use in connection with asymptotic and other approximations. The pertinent integrals were evaluated by several techniques. An adaptive Newton-Cotes routine was found to be the most effective. (auth)

28943 (ORNL-TM-4602, pp 2-111) CENTRIFUGAL FAST ANALYZER DEVELOPMENT. Dec 1974.

In experimental engineering section semiannual progress report (excluding reactor programs) September 1, 1973-February 28, 1974.

Two miniature analytical systems, each based around a miniature Centrifugal Fast Analyzer, have been evaluated in clinical situations. One of these systems is now being routinely operated in the clinical laboratory of the Health Division of the Oak Ridge National Laboratory. A prototype of a rotor capable of accepting, processing, and analyzing a whole-blood sample has been fabricated and is currently being evaluated. Design and development of rotors has continued and includes work on rotors containing preloaded reagents and rotors with parallel transfer channels. To further minimize the size of the analytical system, portable data systems continue to be developed and prototypes tested and evaluated. The latest prototype is battery powered, has selectable data-acquiring intervals, offers the choice of four operating modes, and has been successfully interfaced and operated with a second-generation prototype of a portable Centrifugal Fast Analyzer. This system, consisting of the portable Analyzer and data system (both battery operated), has been evaluated and shown to provide useful analytical data. New applications for the Centrifugal Fast Analyzers are: development of blood grouping procedures, including those for O, B, A, AB, and Rh factors; and development of procedures for specific serum proteins, such as IgG, IgM, IgA, C'3 complement, and α-1-antitrypsin. (auth)

28944 (RISO-316) THEORETICAL AND PRACTICAL INVESTIGATIONS OF ELASTIC SCATTERING OF LASER LIGHT. Hanson, S. (Danish Atomic Energy Commission, Risoe, Research Establishment). Oct 1974. 107p. Dep. NTIS (US Sales Only) $8.50.

The work treats several different topics related to the detection and extraction of information from various laser light scattering devices. The first and second order correlation functions are found for the field scattered from macromolecuses independent of the number of scatterers in the measuring volume. An analysis is made of the transition to Gaussian statistics for the amplitude of the light as the number of particles in the measuring volume increases. A quantum mechanical treatment of the optical field is sketched and an experiment to show one of the differences between a coherent state and a thermal state is described. Experiments concerning scattering from gases and liquids were analyzed theoretically to deduce the influence of the finite measuring volume in the hydrodynamic region and the mean free path in the kinetic region. It is shown how to approximate the transition to the hydrodynamic region from the kinetic region. The detection of low light levels is experimentally verified by the detection of Brillouin scattering from a liquid. The wiring and cooling of the PMT are explained. The reduction of dark counts was measured as a function of the temperature. Finally some optical alignment errors are sketched for a differential laser Doppler velocimeter working the non-coherent mode. The distinction between coherent and non-coherent detection is explained, and the optical constraints for detecting a beat frequency between two spherical waves of different frequencies are calculated analytically. (auth)

28945 (SAND-74-0077) SANDIA LABORATORIES TECHNICAL CAPABILITIES: MEASUREMENT STANDARDS. Lundergan, C. D. (ed.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. Contract AT(29-1)-789. 20p. Dep. NTIS $4.00.

Measurement standards capabilities are characterized. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs. (auth)

28946 (SAND-74-0437) MAGNETIC INDUCTION TELEMETRY FROM BURIED PENETRATORS. Galbraith, L. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1974. Contract AT(29-1)-789. 17p. Dep. NTIS $4.00.

A system is described for the telemetry of digital data from an underground source by means of magnetic induction. The transmitter is a magnetic dipole modulated by the digital data, and the receiving antenna is a large-area coil at the ground surface. Potential penetrator applications were studied using an experimental data package 10 cm in diameter by 30 cm long and requiring 5 watts of battery power. The system has transmitted 150,000 bits at 50 bits per second through 52 meters of soil with a bit error rate of 1.3×10^{-4}, utilizing the 0 to 50 Hz region of the electromagnetic spectrum. Calculations indicate a minimum range for the system of 50 meters in media with conductivities up to and including that of sea water. Range-limiting parameters and proposals for increasing data rate and range are also discussed. (auth)

28947 (SAND-74-5827) ANALYSIS OF A TANTALUM NITRIDE-CHROMIUM-GOLD THIN FILM METALLIZATION SYSTEM AS A FUNCTION OF SUBSTRATE MATERIAL. Knutson, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. AT(29-1)-789. 8p. Dep. NTIS $4.00.

This study was performed to determine whether extra-fine grained alumina or sapphire substrates could be substituted for the more conventional 99.5% alumina substrate as used in a high reliability tantalum nitride-chromium-gold thin film hybrid microcircuit application. Included in this study were investigations of both the tantalum nitride resistor characteristics and the chromium-gold metallization adhesion and bondability. In general, the results confirmed that both extra-fine grained alumina and sapphire could be used satisfactorily as substrate materials. Some of the observations, however, did indicate certain significant sensitivities and also characteristics not in complete agreement with previously published information. Some of these observations were: An extreme sensitivity of the extra-fine grained alumina to surface chemistry modification by etching as detected by lead frame bond strength degradation; improved metallization adhesion to sapphire substrates; and reduced resistor drift on smoother substrates. (auth)

28948 (UCID-16648) TOWARD AN EQUATION OF STATE FOR FINITE-DIFFERENCE COMPUTER PROGRAM. Schroeder, R. C.; McMaster, W. H. (California Univ., Livermore (USA).

Lawrence Livermore Lab.). 3 Dec 1974. Contract W-7405-eng-48. 106p. Dep. NTIS $8.50.

This report first reviews equation of state properties, then discusses the relationship between the shock Hugoniot locus for a shock-compressed porous material and that for the corresponding solid material. From this relationship a procedure is developed for determining the approximate shock Hugoniot locus for the material at any porosity. Experimental data for various materials with different porosities are compared with predictions of the model. (auth)

28949 (UCID-16672) PERFORMANCE OF MICROCHANNEL-PLATE IMAGE INTENSIFIERS UNDER NANOSECOND GATING. Olk, L. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1975. Contract W-7405-Eng-48. 10p. Dep. NTIS $4.00.

The application of microchannel-plate image intensifiers (MCP's) in high-speed photographic systems has created a need to analyze their performance under nanosecond gating conditions. This report gives performance test results for two commercially available units. A 5-nsec effective gate width was measured for both units, and the pulsed resolution was better than 6.8 line pairs per mm. Energy gains of 10^5 were measured for a range of output energies from about 10^{-4} to 10 ergs/cm^2. Pulsed light sources as short as 5 psec were used as MCP illumination during the gated tests. (auth)

28950 (UCID-16695) STRENGTH OF UNDERGROUND CAVITIES. Blake, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Mar 1972. Contract W-7405-eng-48. 37p. Dep. NTIS $5.00.

Data on underground cavities and soil stresses and displacements in relation to the emplacement hardware are discussed. Stability of rock under three dimensional stress was examined. Rock-bolting with regard to the concept of yielded zone is calculated. A comparison of spherical and cylindrical cavities with respect to the required pressure to cause plastic flow is included. Some numerical values of mechanical rock properties, stresses, and displacements obtained on full size cavities in mining operations are given. Rock failure criteria and stability considerations are reviewed with special regard to the Mohr-Coulomb relation between the normal and shear stresses in granular materials. (MCW)

28951 (UCRL-51721) TREATMENT OF WIRES WITH DISCONTINUOUS RADII. Poggio, A. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jan 1975. Contract W-7405-eng-48. 4p. Dep. NTIS $4.00.

Expressions for the current and its derivative near radii discontinuities on wires are derived using a technique originally developed for the treatment of end caps. A numerical implementation is suggested. (auth)

28952 (UCRL-51722) APPROXIMATIONS TO THE KERNEL IN THE ELECTRIC FIELD INTEGRAL EQUATION. Poggio, A. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jan 1975. Contract W-7405-Eng-48. 16p. Dep. NTIS $4.00.

Approximations to the kernel appearing in certain integral equations are derived. The differences in the order of performing angular and axial integrations lead to two different approaches and the results of each approach are presented. Terms not included in the available literature are derived to yield more accurate results. (auth)

28953 (UCRL-51732) PROBABILISTIC DESIGN. Wells, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Jan 1975. Contract W-7405-eng-48. 8p. Dep. NTIS $4.00.

To use probability theory in design, an appropriate statistical propagation technique is required, which is then used to analyze the quantitative design variables. Three such methods—partial derivative, numerical, and Monte Carlo Simulation—are presented. A reliability estimation is also made, using statistical information gained from these analyses and the stress-strength interference principle. Used in proper perspective (i.e., in conjunction with other methods of reliability evaluation), probabilistic analysis can be an effective tool in optimizing system design. (auth)

28954 (UCRL—51767) DIAGNOSTICS DEVELOPMENT FOR MAGNETIC FLUX COMPRESSION EXPERIMENTS. Scudder, J. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Mar 1975. Contract W-7405-Eng-48. 101p. Dep. NTIS $5.45.

Thesis.

A magneto-optic technique employing Faraday rotation was developed for measuring the multi-megabar magnetic pressures generated in magnetic flux compression experiments. This approach, coupled with a sample field probe is capable of providing pressure-volume equation-of-state data over a wide dynamic range. A description of the design and calibration of the instrumentation for magnetic flux compression experiments is made along with a presentation of the results of the isentropic compression of liquid xenon to 140 kilobars. (auth)

28955 (Y-DA-5211) UPGRADING A NUMERICALLY CONTROLLED LATHE FOR IMPROVED PART QUALITY. Hewgley, R. E. Jr.; Douglass, S. S. (Oak Ridge Y-12 Plant, Tenn. (USA)). 25 Feb 1975. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

The effects of wear and wrecks on the performance of machine tools were minimized by the development or use of several new devices. The devices include laser interferometric feedback, spindle thermal growth compensation, automatic tool setting, and a wreck protection system. (auth)

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